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MECHANICAL AND PHYSICAL SCIENCE,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

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JANUARY, 1838.

Practical and Theoretical Mechanics and Chemistry.

On Hydraulic and Common Mortars. By General Treussart, *Inspecteur du Genie. Translated from the French by J. G. Totten, Lt. Col. of Eng. and Brevet Col. United States Army.*

(Continued from Vol. XX, p. 399.)

Art. VII. *Of Artificial Trass and Puzzalona.*

Mr. Baggé, a Swedish Engineer, was, I think, the first who attempted to make artificial puzzalona. This Engineer used, in his experiments, a species of black, and quite hard, schistus; he heated it highly several times; afterwards reduced it to powder, and having mixed it with lime, announced having obtained an excellent mortar, having all the properties of mortar made of puzzalona.

I do not at all doubt the success of Mr. Baggé: but his experiments having been repeated elsewhere, a less satisfactory result was secured. This was owing to using schists of a different composition, and which, in lieu of being heated highly, like those of the Swedish Engineer, required to be heated moderately.

Mr. Faujas de Saint-Fond made several researches in 1778 with the puzzalonas of Vivarais, which he found to be equal to the puzzalonas of Italy. He showed, also, that the trass of Andernach was a true puzzalona.

In 1786 Mr. Chaptal repeated the experiments of Mr. Faujas de Saint-

Fond, on the puzzalonas of Vivarais, and found that they were inferior to those of Italy. This contradiction between the results obtained by Mr. Faujas de Saint-Fond and Mr. Chaptal is easily explained, for one used hydraulic lime in his experiments, and the other used fat lime.

Mr. Chaptal published in 1787 a memoir on the use of the ochreous earths of the south of France. These earths were calcined in a kiln like those used in some countries for burning lime. The kilns are reversed cones from about eight feet eight inches to about ten feet ten inches in height, and are from six to eight feet in diameter at the base: an opening is left near the apex of the cone, through which to withdraw the products of calcination: these kilns are filled by placing alternately, a layer of sea-coal or turf, and a layer of the ochreous earth; the fire is kindled, after a few layers have been placed, and, when it is in full action, other alternate layers are added until the kiln is full. When the lower portion, which was the first heated, is sufficiently calcined, it is withdrawn as fast as necessary, and other new layers of clay and fuel are successively added above. Thus the burning is continual; the clays heat gently near the top of the kiln, and are subject to a much greater heat in the middle: they gradually cool towards the bottom, by the action of the current of air, after the fuel is consumed. This manner of burning earths, possesses great advantages as I shall have occasion to show. It would be equally advantageous to calcine hydraulic limes in these kilns, because, as we have seen above, it is very important to use these limes soon after they are burned. By constructing several kilns of this kind, there might be as great a supply of fresh lime as could be needed.

Mr. Chaptal attributed to iron, a great effect in improving puzzalonas; and he appears to have attributed a very feeble one to alumine. Mr. Vicat says, on this subject, in his memoir: "If, as Mr. Chaptal assures us, clays deprived of iron, and calcined, cannot be employed as puzzalonas, it must be the oxide of iron that acts principally on the silex and modifies it, by the aid of fire in the ochreous earths, as the lime does in the hydraulic limestones: the alumine, therefore, appears to take the least part in these reactions; it does, nevertheless, make part of good puzzalonas."

Experiments which follow will show that iron plays no part in the preparation of puzzalonas, while alumine is very active. We shall see, also, that there is another substance which is very active and which has occasioned the divergencies of opinion on the preparation of puzzalona; but I will not anticipate; and will go on with the statement of the various attempts made to produce factitious puzzalona.

From experiments made at Cherbourg in 1787 by Mr. de Cessart, it appeared that basalts, obtained in the Department of the *Haute-Loire*, and pulverized after having been calcined, produced a mortar possessing all the qualities of those made with Italian puzzalona. Analysis shows this basalt to contain in one hundred parts, the following; Alumine, 16.75; Silex, 44.50; Oxide of iron, 20.00; Lime, 9.50; oxide of Manganese, 2.37; Soda, 2.60; Water, 2.00; loss, 2.28.

The works in the port of Cherbourg required a great quantity of puzzalona; but the war which broke out with England on the rupture of the treaty of Amiens, raised the substance to an exorbitant price: it was calculated that the price of a cubic metre (35.34 cubic feet) cost, in 1803, more than 400 francs (about $76.00.)

They might easily have procured on the spot, clays which would have given results absolutely the same as those afforded by Italian puzzalona, at

the cost of about 30 francs (about $6.00.) And had they understood the manner of making puzzalona, there would have been a great saving. Considerations of this sort induced Mr. Gratien, Senior, Engineer of roads and bridges, to occupy himself with the subject. He made a few essays with the porcelain clay of Valognes, and made many with the schists of Haineville, which he calcined, in repetition of the experiments of the Swedish engineer. The Valognes clay calcined, gave but feeble results; the Haineville schists gave better; analysis showed this schist to consist, in 100 parts, of the following: alumine, 26.00; silex, 46.00; magnesia, 8.00; lime, 4.00; oxide of iron, 14.00; loss and water, 2.00. The results of the experiments of Mr. Gratien, Senior, are given in two memoirs which he published, one in 1805, the other 1807. A commission of the Institute was charged with examining experiments, comparative of mortars made of puzzalona, of trass, and of the Cherbourg schist; the judgment of this commission is inserted by Mr. Gratien in his memoir of 1807, page 9; it declares "that after taking from the water the twelve boxes of beton of different compositions:

"1st. All had acquired a certain consistence, but very different amongst themselves.

"2nd. The difference was striking between the betons composed of puzzalona and trass, and those into which these substances did not enter.

"3rd. The two compositions of burnt and pulverized schistus offered a resistance quite satisfactory, but not so great as it probably would be after a longer immersion.

The above report shows that Mr. Gratien obtained with the schists, results inferior to those given by puzzalona.

In 1806 Mr. Le Masson, Engineer of roads and bridges, at Rouen, attempted, in concert with Mr. Vitalis, to make factitious puzzalona by calcining yellow ochreous earths, according to the process of Mr. Chaptal. The betons made with the calcined earth, having acquired a remarkable consistence, Mr. Le Masson, in 1807, repeated the experiments on a larger scale: he immersed, in the Seine, casks filled with beton made of the calcined ochreous earth. After six months, the casks were taken out, and it was found that the betons had acquired such hardness that it was necessary to strike it two hundred times with a mass of iron weighing $26\frac{4}{10}$ lbs. to break in a depth of ten to twelve inches; the tenacity was so great, that the entire mass weighing 2800 lbs. was suspended by means of a *tire fond* (lewis?) Mr. Gratien and Mr. Vitalis judged that the masonry had acquired a hardness greater than could ever be absolutely necessary, even in constructions that require the greatest solidity in their foundations. These experiments are reported in the memoir of Mr. Gratien 1807—page 46 and following.

Mr. Vicat in his memoir of 1818 confined himself to reporting the different attempts that had been made, up to that time, to form artificial puzzalona: but in 1819 he sent to the Institute a memoir on that subject. I do not know whether this memoir was printed, but an extract is contained in the *annales de chimie et de physique* of 1820, Vol. XV, page 365 and following. After several observations on limestone, on the action of fire on calcareous stones, and the combination of water with lime, the author gives a succinct history of puzzalona. We find afterward the following passage.

"Since the quality of natural hydraulic lime, depends solely on the presence of a certain quantity of clay, combined by fire with the calcareous matter, it was natural to think that by mixing clay in suitable proportions with fat lime, slaked, no matter how, and then submitting the mixture to

calcination, a similar result would be obtained: experiments made on a large scale, and in many places, have confirmed this idea in a manner so complete, that it is now possible to fabricate any where, and at a very moderate price, artificial lime superior to the natural analagous lime."

"In like manner, since chemical analysis gave, for the constituents of natural puzzalona, silex, alumine, oxide of iron, and a little lime; it was easy to suppose that our clays, of which the composition is altogether similar, might be transformed, by burning, into artificial puzzalonas. This idea was already old at the period of the experiments of the author of these researches; but by a remarkable fatality it was as if stricken with sterility: the circumstances on which the quantities of good puzzalona depend, had not been determined with sufficient precision. There was a persuasion, for example, that iron was very active therein; that, therefore, only ochreous clays should be used; that in order to a more perfect imitation of nature, there should be a high degree of heat, 'because,' said they, 'the fire of volcanos is much more intense than the fire of our kilns.' (Several geologists are of a contrary opinion.) Certain puzzalonas, came, beyond doubt, in the form of lava, from volcanos: they were in fact subject to a high degree of heat; but since the very distant epoch of their formation, they have sustained diverse decompositions, either from intestine modifications or from the action of acid vapours, or from other causes, and these decompositions have totally changed the mode of combination of their principles. As to the red puzzalonas of the neighbourhood of Rome, every thing shows that they were only vast beds of ochreous clay variously burned, either by subterranean fires, or by currents of lava which covered them and broke them up in every direction. Thus their quality is very variable according to the disposition and depth of the beds. But whatever may be the process of the formation of these substances, it is demonstrated that all the mystery of their properties, resides, not in the presence of iron or lime, but in a particular state of combination of silex and alumine—a state to which all clays, soft and greasy to the touch, may be brought, with the greatest facility, by a light calcination. The means which hitherto appear to have succeeded best, consists in reducing the dry clay to a very fine powder, and calcining it, for some minutes, on metallic plates heated to an obscure (*brun*) red. The truth is, that practice has not yet fully matured the process, and it is probable that full success requires the contrivance of a mode of calcination more expeditious and convenient than the above: but the problem is not the less resolved."

Such is the mode proposed by Mr. Vicat for making factitious puzzalona; and he teaches us nothing new, for he does not tell us what is the particular condition in which the silex and alumine should be found to afford good results. Opinions were for a long time divided on the question whether the clays, which it was desired to convert into good cements, should be heated much or little—these cements being, really, artificial puzzalonas.* Mr. Vicat has adopted the opinion of those who thought they should be burned but little; but experiments which are to follow will show that this (as a general principle) is erroneous—it being necessary to burn more or less, according to the composition of the clay. The problem, therefore, was not resolved by Mr. Vicat, though he says it was; and the experiments which follow will show in what it really consists.

* By the term *ciment*—translated, in the above sentence, *cement*, the French often mean, simply brick dust or tile dust; and it will be so rendered wherever it is supposed to bear that meaning.—Trans.

I made several essays, substituting brick and tile dust for trass. To this end I composed a number of mortars of fat lime and the dust of bricks or tiles taken from all the kilns of the neighbourhood. A part of the mortars were made of brick dust, and a part of tile dust. I obtained many results: —sometimes very good, sometimes indifferent, and sometimes very bad. What struck me much, at first, was, that mortars made of different dusts coming from the same burning gave very different results: notwithstanding that the dusts were of the same burning, were all made of the same clay, were used with the same lime, and that all other circumstances were the same. I saw from this, that great risk was run of making bad mortar, by taking brick or tile dusts without discrimination. I know that the great majority of constructors preferred highly burned dusts, and that, although made of the same clay, they much preferred dust of tiles to that of bricks. To settle my opinion on these two points, and to explain up contradictory results that I had obtained, I made the experiments reported in the following table.

Table No. XVI.

No. of the mortar.	Composition of the mortar.			No. of days required to harden in water.	Weight supported before breaking.
				days.	lbs.
1	Fat Lime slaked to powder and measured in powder . .	1	3	11	330
	Dust of bricks but little burned .	2			
2	Lime the same . .	1	3	+40	180
	Dust of bricks well burned .	2			
3	Lime the same . .	1	3	5	275
	Dust of tiles but little burned . .	2			
4	Lime the same . . .	1	3	+30	125 *
	Dust of tiles well burned .	2			
5	Lime the same . .	1	3		
	Dust of tiles same as No. 3 but which had been reburned in a reverberatory furnace for six hours.	2			

Observations on the experiments of Table No. XVI.

In order to make the above five experiments, I went to the nearest brick-yard, at Strasburg; and there got bricks and tiles, both lightly burned, and well burned. It was easy to dintinguish them, for the first were very red, and but feebly sonorous, while those which were *well burned*, as it is called, were of a fawn colour (*fauve*) (pale red) and quite sonorous. The burners are never mistaken in this particular.

The first four experiments show that I obtained much better results with bricks and tiles but little burned, than with those well burned. We see, also, that the hardening was much more prompt, with the slightly burned dusts: for No. 2 required more than forty days to harden, while No. 1 required but 11 days; No. 4 took more than 30 days to indurate, while No. 3 took but 5 days. We see, also, contrary to the theory general opinion, that brick dust gave better results than tile dust. No. 5 was made with the

* In my pamphlet of 1824, and in the 7th number of the *mémorial*, copied therefrom, the resistance, by a typographical error, is set down as 87 kil. (194 lbs.) Au.

same dust as No. 3, after it had been reburnt for six hours in a reverberatory furnace, keeping it constantly at a low red heat. The mortar made of this last dust took no consistence, and when I withdrew it from the water after a year, it was as soft as if it had been made of lime and sand only. This shows how important it is not to use these dusts at hazard; for they are always costly and are sometimes no better than so much sand. More than one fault of this kind has been committed in great works, as I shall have occasion to remark. The experiments of the above table agree with the opinion of Mr. Vicat, who says, that clay should be submitted to a feeble heat only. But on resorting to another tile kiln, where they used another clay in making bricks and tiles; and making therewith four new experiments exactly like the first four in the above table. I was surprised to find results directly opposite to those before obtained; that is to say, the dusts furnished by bricks and tiles but little burned, gave results much inferior to those afforded by the dusts from well burned bricks and tiles. The experiments in the following table, were made with this cement.

Table XVII.

No. of the mortar.	Composition of the mortar.		No. of days required to harden in water.	Weight supported before breaking.
			days.	lbs.
1	Fat lime slaked to powder and measured in powder . . Dust of tiles but little burned .	1 2 } 3	12	139
2	Lime the same . . . Dust of No. 1 reburnt for half an hour	1 2 } 3	12	176
3	Lime the same . . . Dust of No. 1 reburnt for one hour .	1 2 } 3	15	282
4	Lime the same . . . Dust of No. 1 reburnt for two hours .	1 2 } 3	20	319

Observations on the experiments of Table No. XVII.

To make the experiments of table No. XVII, I took dust from the tile kiln which had given results opposite to those in table No. XVI, dust but lightly burned, and made mortars therewith, in its then state, and also after it had been reburnt.

Mortar No. 1 contains the slightly burned dust, and Nos. 2, 3 and 4 the same dust after it had been reburnt for the periods of time expressed in the table. According as the dust was burned more and more, the resistance increased; and it is probable it would have been further augmented by further burning. It should be noticed that the induration became slower as the resistance became greater. We shall see, below, that the slowness of the hardening is due to the dusts having been heated in crucibles, where they were out of contact of the air.

We see that the dusts of table No. XVI gave me good results only when they had been but little burned, while it was the contrary with those of table No. XVII. These opposite results led me to examine the composition of the clays of these two brick yards; and I ascertained that the clay which gave the dust of table No. XVII contained very little carbonate of

lime, while that which produced the dust of table No. XVI, contained almost a fifth of its weight of that substance. I repeated the experiment with the clays of several other tile kilns, and I always obtained this remarkable result, namely, when the clays contained little or no carbonate of lime, gentle burning imparted only mediocre qualities, while strong burning gave them excellent qualities. When, on the contrary, the clays contained from one to two tenths of carbonate of lime I procured good results only by heating lightly, and, if I augmented the degree of calcination the quality was impaired; and if the heat had been very great, all hydraulic property was lost. We see, consequently, that Mr. Vicat was in error in saying, as I have already quoted him at page 4, "that all the mystery of puzzalona resides, not in the presence of iron or lime, but in a particular state of combination of silex and alumine." It is certain, on the contrary, that the presence of lime in clays has a great influence on the quality of the puzzalona. At the same time we may conceive why those who had been engaged in producing this substance, were induced to announce, some, that it was necessary to heat clays but little, and others that it was necessary to heat them highly. It follows from what I have said that what was true of one kind of clay might not be true of another, although having the same aspect. We in no degree contest the point, for example, of Mr. Le Masson having obtained, at Rouen, very good results with a calcined ochreous earth; but had he submitted to the same degree of calcination an ochreous earth of the same appearance, but containing more or less lime, he would have had very different results. If two clays, equally greasy to the touch, be taken, of which one shall contain one fifth of lime, while the other contains none, and if they be equally heated, it may happen that neither of the results will possess hydraulic properties of any moment: that which contained the lime will have been too much burned, while that which was without lime will not have been burned enough. On the other hand if that containing lime be less burned and that having no lime be more burned, then very good results may be had from both.

The above experiments were made in the autumn of 1821. As they are the foundation of the fabrication of artificial puzzalonas, and as the important part that lime acts in this fabrication had not been noticed, I addressed, in 1822, to the Minister of War, a memoir containing the result of my experiments. An extract from this memoir may be found in the *Moniteur* of January 22nd, 1823.

Mr. Sganzin reports, page 31 of his *cours de construction*, that "they prepare at Amsterdam an artificial trass: it is clay taken from the bottom of the sea, which they burn highly as they do bricks. These brick-like pieces are broken by pestles worked by horses: the substance is then put under millstones, where it acquires the fineness necessary to be converted into mortar by mixture with lime.

"Bergman analysed this artificial trass, which bears the name of *privileged cement of Holland*: he found that it contained in about 100 parts Silex, from 55 to 60; Alumine, 19 to 20; Lime, 5 to 6; Iron, 15 to 20.

There is no doubt, considering the composition of this clay, and the degree of heat to which it is subjected, that it must give very good artificial trass.

I give below, in a table, some experiments on clay which I calcined after mixing with it a little lime.

Table No. XVIII.

No. of the mortar.	Composition of the mortar.		No. of days required to harden in water.	Weight supported before breaking.
			days	lbs.
1	Fat lime slaked to powder and measured in powder . . Dust from Holsheim clay .	1 2 } 3	12	319
2	Lime the same . . Same clay calcined with 0.10 of lime	1 2 } 3	23	169
3	Obernai lime slaked to powder and measured in powder . Dust of Holsheim clay . .	1 2 } 3	10	440
4	Obernai lime do. . . Same clay calcined with 0.10 of lime	1 2 } 3	23	216

Observations on the experiments of Table No. XVIII.

To make the above experiments, I slaked fat lime to dry powder, and fixed the quantity by measuring in powder: and I took Holsheim clay of which the composition is given at p. 378: vol. xx; it contains no lime. I calcined a portion of this clay in a crucible placed in a reverberatory furnace, keeping it at a red-heat during twelve hours. I took the same clay, mixed it with one-tenth its volume of fat lime reduced to paste, and heated the mixture in the same way and for the same time, as the clay alone. I then made mortars 1 and 3 of the above table, mixing fat lime and the Obernai hydraulic lime, with the clay dust that contained no lime: the numbers 2 and 4 were made with the clay dust mixed with one-tenth of lime.

The results of the table show that the mortar made with fat lime, and clay dust containing lime, gave a resistance only one half of that obtained with same lime, and clay dust containing no lime. The table shows that I got like results with mortars made of Obernai lime. It will also be seen that the hardening was slower, by one half, with the dust containing lime, than with that without lime. Besides, these mortars took much more time to harden than they should have taken; this is owing to the clay dusts having been calcined in a crucible, and to the experiment having been made in winter.

Mr. Sganzin states, page 27 of his *cours de construction* that the officers of Engineers who constructed the sluice-bridge at Alexandria reburnt their brick dust to a high degree; and he says it was because, before this operation, the mortars melted (*se délayait*) in the water. Mr. Vicat also, mentions this process which he approves, but for another reason; his opinion is that energetic puzzalonas suit better with fat lime than with hydraulic lime; he has remarked that on highly heating puzzalona, it loses all its energy, and I have obtained the same effect. But the lime used in building the Alexandria bridge was Casal lime, which is eminently hydraulic. Mr. Vicat thinks, therefore, that the brick dust was calcined to diminish its energy, so that it might make better mortar with the Casal lime. This is a great error. The officers of Engineers in calcining this brick dust to a high

degree, committed a serious fault as I shall prove. But it is first necessary to show in what the error of Mr. Vicat consists. This Engineer relies on the principle, that mortar made of hydraulic lime, sand, and good cement, is superior to that made of lime and cement without sand. The first experiments of my table, Nos. 2 and 3, also show, that with good hydraulic lime, sand and trass or puzzalona, I obtained better results than with lime and trass or puzzalona without sand. But if we refer to table No. XIII, we shall see that, with a few exceptions, I obtained similar results with fat lime. If we compare the results of Nos. 9, 10, 11 and 12, all made of the same lime from marble, same trass and puzzalona, we see that if No. 9, containing sand, is inferior to No. 10, containing only lime and trass, on the other hand No. 11 which contains sand, is superior to No. 12 containing puzzalona without sand. To complete the conviction, it will suffice to cast the eyes over table No. XVIII; wherein we see that by the addition of one-tenth of lime to the Holsheim clay, and the degree of burning to which I submitted it, I considerably diminished the energy of this factitious trass: but it appears that this slightly energetic clay dust, gave, both with common lime, and with the Obernai hydraulic lime, a result only one half as good as that obtained with the same lime, and the clay dust in all its energy. The experiments cited, prove then, that energetic puzzalonas suit equally with very hydraulic lime and with fat lime. They prove that with these two kinds of lime it is in general more advantageous and economical to make mortars of lime, sand and puzzalona whether natural or artificial, than with lime and puzzalona only. If in certain cases, there is found to be a superiority in mortar without sand, we see that it is not great, and, on account of the considerable economy that results, we ought not to hesitate to use sand.

The observation cited by Mr. Sganzin, as to the sluice-bridge at Alexandria, would be entirely in opposition to the results Mr. Vicat and I have obtained by calcining clay dusts and puzzalonas to a high degree. We found that these substances thus calcined, lost all their energy, while, according to Mr. Sganzin, they require to be submitted to an elevated temperature. I did not doubt that Mr. Sganzin had been incorrectly informed as to what occurred at Alexandria; but, to be certain, I examined at the Depot of fortifications the documents relative to the works of that place, and I found, in a memoir of the *Chef de bataillon* Maynial, of the Engineers, dated 23 *brumaire an* 13, relating to this sluice-bridge what follows: The first season the floor (*radier*) was constructed of brick masonry in puzzalona mortar: the difficulty of procuring puzzalona, and its high price, led to the construction of a reverberatory furnace in which brick dust was reburnt to incandescence, so that when stirred it would flow like lava (*jusqu'a incandescence, de maniére que, lorsqu'on le remuait, on le voyait couler comme de la lave.*) The mixture of mortar, was one third of this reburnt brick-dust, one third sand, and one third Casal (lime,) and it produced the same effect as a like mixture of puzzalona."

We see that it was the difficulty of procuring puzzalona, that gave the idea of reburning the clay dust to the point of fusion, and that they were led to this degree of calcination by the false notion that puzzalona was lava—these two substances, being in fact, very different. It is not said in the memoir that the mortar made of this dust, before reburning it, melted in water, as Mr. Sganzin states: and it could not have been so, since they used the Casal lime, which is very hydraulic. We see, moreover, that it was not with a view to diminish the energy of the cement, and because

it was to be used with very hydraulic lime, that it was reburnt; on the contrary they wished to impart to it the force of puzzalona, which they imagined had been melted like lava. The memoir says that this recalcined dust, produced the same effect as a like mixture of puzzalona. If they had mixed it with fat lime, there would have been a great difference between the results with this dust and those obtained in the same way with puzzalona. It is evident that their result ought to have been good, as it is stated to have been, at the end of the memoir, but it was owing entirely to the Casal lime being so eminently hydraulic. We have seen in the first tables that very hydraulic limes gave very good resistances without any admixture: if they had been mixed with broken nut shells, or with chopped straw, we should still have had a good result, but it would have been very wrong to attribute the result to those substances. By reburning the brick dust at so high a heat, they destroyed all its hydraulic properties; and they would have had as good a mortar by mixing this very hydraulic lime with sand, instead of the dust they used; and at a much cheaper rate. I repeat then that they committed a great fault at Alexandria in reburning the clay dust thus highly, since they necessarily caused it to part with all its hydraulic properties, and, in order to do this, encountered great expense. Before calcining the dust, if they thought proper to use it, they should have tried it with a little fat lime, to ascertain whether, or not, it would be advantageous to burn it more. I have enlarged on this example of the works of Alexandria, to show how important it is not to have false ideas as to puzzalonas, or the substances which are substituted for them. I proceed now to repeat other experiments that I made with diverse clays mixed with lime and calcined to different degrees.

Table No. XIX.

No. of the mortar.	Composition of the mortars.			The clay having been burnt with lime.		The clay having been burnt with bricks.	
				H	W*	H	W
1	Fat lime slaked to powder & measured in powder Trass	1 2	3	days	lbs.	days	lbs.
2	Lime the same Puzzalona	1 2	3				
3	Lime the same Dust of Holsheim clay	1 2	3	25	187	15	275
4	Lime the same Dust of Holsheim clay with lime water	1 2	3	25	143	15	286
5	Lime the same Dust of Holsheim clay with 0.01 of lime	1 2	3	25	165	15	297
6	Lime the same Dust of Holsheim clay with 0.02 of lime	1 2	3	30	110	10	319
7	Lime the same Dust of Sufflenheim clay	1 2	3	25	165	15	297
8	Lime the same Dust of Sufflenheim clay with lime water	1 2	3	25	220	15	286
9	Lime the same Dust of Sufflenheim clay with 0.01 of lime	1 2	3	25	143	15	286

*In this table and several others which follow, the columns marked H, express the number of days the mortar required to harden in water, and those marked W, indicate the weights supported before breaking. Au.

Table No. XIX.—(Continued.)

No. of the series.	Composition of the mortars.		The clay having been burnt with lime. H	W	The clay having been burnt with bricks H	W
10	Lime the same . . . 1 Dust of Sufflenheim clay with 0.02 of lime 2	3	25	121	12	275
11	Lime the same . . . 1 Dust of pipe clay . . 2	3	25	264	15	308
12	Lime the same . . . 1 Dust of pipe clay with lime water . 2	3	25	264	15	330
13	Lime the same . . . 1 Dust of pipe clay with 0.01 of lime . 2	3	25	275	15	341
14	Lime the same . . . 1 Dust of pipe clay with 0.02 of lime . 2	3	25	275	12	363

Observations on the experiments of Table No. XIX.

To make the above experiments I took three kinds of clay, that of Holsheim, of Sufflenheim, and the pipe clay of the environs of Cologne: the composition of these clays may be seen at p. 378, vol xx. I made four bricks of each of these clays: the first contained no foreign substance: the second was made by adding a quantity of lime water equal to the bulk of clay; the third by adding one per cent. of fat lime in paste, and the fourth by adding two per cent of the same lime; they were placed in a lime kiln in the midst of the lime.* With each of the same clays I made, also, four other similar bricks which I placed in the same kiln with the common bricks. Lastly, having calcined these cements, I made the mortars which are given in the table, taking one part of fat lime, measured in powder, to two parts of each of these cements. No. 1 and 2, were made of the same lime and trass or puzzalona, to serve as comparisons with the other experiments. The mortar of trass hardened in six days, and broke under a weight of 264 lbs: that of puzzalona hardened in four days and supported 352 lbs. before breaking. The hardening has in general been a little slower; although these experiments were made at the end of summer. That may possibly be owing to the degree of burning of the lime.

On examining the above table we shall remark that all the clays that were burned with the lime, including the natural clays, gave results, less good, than when burned with the bricks; this difference is much greater with the clays which contain lime; we see that when burned with the bricks the Holsheim clay, and the pipe clay, gained a little by the addition of a small quantity of lime, while the Sufflenheim clay, on the contrary, lost a little. When they were burned with the lime, the Holsheim clay lost strength; that of Sufflenheim presented anomalies which I cannot explain, and the pipe clay was but little changed.

The Holsheim clay being most at command. I made with it several mixtures of lime up to one tenth, and I burned them in the same way as the above clays: the following table contains the results.

*Throughout all Alsace, they burn lime in large square, and elevated kilns, lime is put at bottom, bricks are placed above the lime, and tiles above the bricks: they burn with wood, which is placed at the bottom: so that the lime is most highly heated, and the tiles the least. Au.

Table No. XX.

No. of the series.	Composition of the mortars.		Clay burned with lime.		Clay burned with bricks.	
			H	W	H	W
			days	lbs	days	lbs
1	Fat lime measured in paste . 1 Trass . . . 2	2				
2	Lime the same . . 1 Puzzalona . . . 2	3				
3	Lime the same . . 1 Dust of Holsheim clay . . 2	3	25	253	15	396
4	Lime the same . . 1 Dust of Holsheim clay with 0.01 of lime . . 2	3	25	209	15	319
5	Lime the same . . 1 Dust of Holsheim clay with 0.02 of lime . . 2	3	25	242	15	297
6	Lime the same . . 1 Dust of Holsheim clay with 0.03 of lime . . . 2	3	25	231	15	286
7	Lime the same . . 1 Dust of Holsheim clay with 0.04 of lime . . 2	3	25	253	15	341
8	Lime the same . . 1 Dust of Holsheim clay with 0.05 of lime . . . 2	3	25	275	15	352
9	Lime the same . . 1 Dust of Holsheim clay with 0.06 of lime . . . 2	3	25	231	15	297
10	Lime the same . . 1 Dust of Holsheim clay with 0.07 of lime . . . 2	3	25	198	15	275
11	Lime the same . . 1 Dust of Holsheim clay with 0.08 of lime . . 2	3	25	198	15	286
12	Lime the same . . 1 Dust of Holsheim clay with 0.09 of lime . . . 2	3	25	231	15	297
13	Lime the same . . 1 Dust of Holsheim clay with 0.10 of lime . . . 2	3	25	242	15	286
14	Lime the same . . 1 Dust of Holsheim clay with 0.04 of lime . . . 2	3			4	187
15	Same mortar				4	209
16	Same mortar				3	297
17	Same mortar				3	385

Observations on the experiments of Table No. XX.

The above experiments were made in the same manner as those of table No. XIX, as to the burning of the clays; but in proportioning the mortars I took one part of lime in paste to two parts of cement. I made two comparative experiments, No. 1 and No. 2 with trass and puzzalona. The mor-

tar with trass hardened in four days and supported 319 lbs; that with puzzalona hardened in three days and broke under a weight of 286 lbs. We have seen in table No. XIII, an exactly similar mortar support 495 lbs. Whence it appears that with puzzalona as with trass, results are various.

The present table concurs with No. XIX in showing that the cements calcined with the lime gave inferior results to those calcined with the bricks. This table shows also that the proportions of lime mixed with the clay, which gave the best results for the degrees of calcination tried, were four or five per cent; but here, the best result obtained from clay mixed with lime, is inferior to that of No. 3 where there was no lime. It appears that the mortars of the two tables whereof the clay had been calcined with 0.02 of lime do not greatly differ. A greater difference observable between the mortars No. 3 of the two tables, neither of which contain lime, may be owing to two circumstances: the first is, that in table No. XIX the proportions were adjusted with lime in powder, while in No. XX, they were fixed with lime in paste; the second is, that the cement of mortar No. 3 in the present table may have received a more suitable degree of calcination than that of table No. XIX.

All the four mortars No. 14, 15, 16 and 17 were made with clay that had been mixed with 0.04 of lime, but they were heated to different degrees in another kiln, and gave different results. Cement No. 14 was burned with the tiles and placed in the upper part; No. 15 was placed in the middle of the kiln; No. 16 between the tiles and the bricks, and No. 17 in the middle of the bricks. Whence it appears that No. 14 was least and No. 17 most heated. This last mortar gave about the same resistance as No. 3 which contained no lime.

There are several anomalies in the last column of table No. XX which appear to me to be due to the degree of calcination. We notice, in fact, that in a brick kiln, not only the different layers sustain different degrees of heat, but even the bricks in the same layer are not all burned to the same degree. All the mortars of the last column of the last two tables, required about fifteen days to harden, with the exception of the last four which hardened in the short space of three to four days. I attribute this effect to the circumstance that these four cements were placed by the side of one of the flues left in the mass of bricks in order to distribute the heat; and thus they were exposed, during the burning, to a current of air which contributed to the promptitude of the induration, as I shall have occasion to show.

The experiments given in tables Nos. XVI, XVII, XVIII, XIX and XX, show that the presence of lime has great influence, when it exists in the state of carbonate in the clays, as to the effect of calcination upon them; because the heat disengages a great part of the carbonic acid, and the lime mixed in the clay, causes the beginning of vitrification, which is distructive of all hydraulic properties in these cements. These experiments show, besides, 1st. that clay containing no lime requires a rather high calcination to form good artificial puzzalonas, and that the heat required to burn bricks suitably, is about the proper degree for such cements: 2nd. that when the clays contain as high as one tenth of carbonate of lime, the temperature used to burn tiles is sufficient: 3rd. that this degree of heat is too great for them, provided they contain from a tenth to a fifth of carbonate of lime, as sometimes happens, but that good results may still be got by burning them with a lower heat than that required for tiles: 4th. it does not appear that the presence of lime in clays tends to make the cements more ener-

getic. If it gives energy to some clays, it is but slight: and there may result from the mixture, if the burning be carried too high, a loss of all hydraulic property. At the close of the chapter I shall explain all the means necessary to the fabrication of good artificial puzzalona.

Among the substances which, after lime, occur most frequently in clays, is magnesia. I, in consequence, made the following experiments with Holsheim clay and various proportions of carbonate of magnesia.

Table No. XXI.

No. of the mortars	Composition of the mortars.			No. of days required to harden in water.	Weight supported before breaking.
				days.	pounds.
1	Fat lime measured in paste . . . Dust of Holsheim clay . .	1 2	3	20	380
2	Lime the same . . . Dust of the same clay with 0.01 of carbonate of magnesia . .	1 2	3	20	341
3	Lime the same . . . . Dust of the same clay with 0.03 of do.	1 2	3	20	330
4	Lime the same . . . Dust of the same clay with 0.05 of do.	1 2	3	20	341
	Lime the same . . Dust of the same clay with 0.07 of do.	1 2	3	20	330
6	Lime the same . . . Dust of the same clay with 0.10 of do.	1 2	3	20	350
7	Lime the same . . . Dust of the same clay, highly heated, with 0.05 of carbonate of magnesia	1 2	3	20	231

Observations on the Experiments of Table No. XXI.

I made the above mixtures of Holsheim clay with carbonate of magnesia in the same manner as, in the preceding tables, the mixtures of clay and lime. We see that the hardening was slower than usual; but this is owing to the experiments having been made during very cold weather in the month of January.

These clays were placed in the lime kiln between the bricks and the tiles, and we see by the result of No. 1 that the degree of heat was not quite sufficient to impart to this clay all the energy of which it is susceptible. We see also, that at this degree of heat, the carbonate of magnesia has had no great effect in transforming this clay into puzzalona. The cement No. 7 was more highly heated, being placed between the bricks and the lime: the clay of this number contained the same quantity of carbonate of magnesia as No. 4 and we see that it supported 110 lbs. less. We should not conclude that this effect is due to the magnesia; because the Holsheim clay loses, when alone, much of its force when too highly heated, as we see by No. 1 of table XXIII. It appears, therefore, that magnesia is nearly passive in the perfecting of artificial puzzalonas.

Clay, we know, is a mixture of silex and alumine: I, in consequence, made the following experiments, adding sand to the clay which I heated.

Table No. XXII.

No. of the mortars.	Composition of the mortars.			No. of days required to harden in water.	Weight supported before breaking
				days	lbs.
1	Fat lime slaked to powder and measured in powder . .	1	3	12	418
	Dust of pipe clay heated for six hours in a reverberatory furnace .	2			
2	Lime the same . .	1	3	14	374
	Same clay deprived of part of its sand, and to which was added 0.10 of white sand pounded fine . .	2			
3	Lime the same . .	1	3	15	378
	Dust of clay No. 2 with 0.20 of sand do.	2			
4	Lime the same . .	1	3	15	383
	Dust of clay No. 2 with 0.30 of sand do.	2			
5	Lime the same . .	1	3	15	473
	Dust of clay No. 2 with 0.40 of sand do.	2			
6	Lime the same . . .	1	3	15	462
	Dust of clay No. 2 with 0.50 of sand do.	2			
7	Lime the same . .	1	3	16	187
	Dust of yellow ochreous clay .	2			
8	Lime the same . .	1	3	20	143
	Dust of yellow ochreous clay, deprived of part of its sand . .	2			
9	Lime the same . . .	1	3	20	165
	Dust of clay No. 8 with 0.10 of white sand pounded fine . .	2			
10	Lime the same . . .	1	3	18	176
	Dust of clay No. 8 with 0.20 of sand do.	2			
11	Lime the same . . .	1	3	16	189
	Dust of clay No. 8 with 0.30 of sand do.	2			
12	Lime the same . . .	1	3	18	154
	Dust of clay No. 9 with 0.40 of sand do.	2			
13	Lime the same . .	1	3	20	132
	Dust of clay No. 8 with 0.50 of sand do.	2			
14	Lime the same . . .	1	3	12	352
	Dust of clay called Rintzel .	2			
15	Lime the same . . .	1	3	10	418
	Dust of Rintzel clay deprived of part of its sand . . .	2			

Observations on the experiments of Table No. XXII.

To make the first six experiments, I took the white clay which is sent from the environs of Cologne to Strasburg, to make pipes. The analysis of this clay, given in vol. xix, p. 378, shows that it contains very little iron, and that the alumine in it, is about one third of the silex. I took a portion of this clay, diffused it through a large quantity of water, and decanting it several times, deprived it of a part of its silex. I then made the mortar No. 1 with the natural clay: the other mortars up to No. 6 inclusive were composed with the clay deprived of part of its silex, to which I added, successively, the portions of sand stated in the table. The sand which I used was white and silecious: it was pounded very fine and mixed with the clay.

I omitted composing a mortar of lime, and this white clay deprived of

part of its sand, like that, No. 8, made of another kind of clay. The clay of the first six numbers was calcined during six hours in a reverberatory furnace. No. 2, which had less sand than No. 1, gave a result less strong. The quality of the succeeding mortars improves up to No. 5, to which I had added 0.40 of sand; No. 6, which contained 0.50 of sand, was inferior to No. 5.

The experiments from No. 7 to No. 13 were made with a very greasy clay: a yellow ochreous earth of which I had not the analysis. I treated this clay like the other, that is to say, I took a portion which I washed in a great quantity of water, decanting several times to separate a portion of the sand it contained. No. 7 was made with the natural ochreous earth: No. 8 with the clay deprived of a portion of its sand. To make the following mortars up to No. 13, I added to the washed clay the several portions of sand indicated in the table; these clays, like the pipe clay, were heated for six hours in a reverberatory furnace, keeping them at a low red heat (*rouge tendre.*) We see that, with this clay as with the pipe clay, we obtained an inferior result when it was deprived of much of its sand, and that its energy was augmented by adding a little sand, up to a certain quantity, beyond which it went on diminishing. The comparison of the above experiments with ochreous clay and pipe clay, shows that ochreous earths are not, as was for a long time believed, to be preferred in forming artificial puzzalonas: several other results confirm this remark.

The experiments No. 14 and 15 were made with a clay which is found in the environs of Haguenace, and is used for various purposes; this clay is gray, and contains no lime: it is refractory. It is used in the construction of furnaces for heating madder. On working it in the hands, it is perceived to contain a considerable quantity of sand. No. 14 is composed of the natural clay: in No. 15, the clay is deprived of part of its sand, and in this state it is much more greasy to the touch. A comparison of No. 14 and 15 shows that this clay gave the best result when deprived of part of its sand.

The experiments made with the above three kinds of clay prove that clays containing a great quantity of sand are not so suitable for making artificial puzzalonas as those which, having more alumine, are greasy to the touch. When clays contain one part of alumine to three of silex, they are very greasy: they are also quite greasy when the proportion is one to five, but beyond this they become meagre: it is therefore amongst the clays a little greasy, that we should seek for those whereof to make artificial puzzalona.

We have seen, according to the analysis, by Mr. Berthier, of trass and puzzalona, that these substances contain potash and soda. I therefore mixed these with the clays to be heated, and the following are the results.

Table No. XXIII.

No. of the mortar.	Composition of the mortars.		Clay having been burned with bricks. H	Clay having been burned with bricks. W	Clay having been burned with lime. H	Clay having been burned with lime. W
			days.	lbs.	days.	lbs.
1	Fat lime measured in paste . 1 Dust of Holsheim clay . 2	3	15	330	25	99
2	Lime the same . . 1 Dust of same clay with 1-10 of solution of soda at 5° . 2	3	15	319		
3	Lime the same . . 1 Dust of same clay with 1·5 do. 2	3	15	308		
4	Lime the same . . 1 Dust of same clay with 1-4 do. 2	3	15	297		
5	Lime the same . . 1 Dust of same clay with 1-3 2	3	15	297		
6	Lime the same . . 1 Dust of same clay with 1-2 . 2	3	15	286	15	297
7	Lime the same . . 1 Dust of same clay with 1-10 of solution of potash at 5° . 2	3	15	341		
8	Lime the same . . 1 Dust of same clay with 1-5 do. 2	3	15	363		
9	Lime the same . . 1 Dust of same clay with 1-6 do. 2	3	15	374		
10	Lime the same . . 1 Dust of same clay with 1-3 do. 2	3	15	363		
11	Lime the same . . 1 Dust of same clay with 1-2 do. 2	3	15	341	25	264
12	Lime the same . . 1 Dust of same clay with 1-2 of solution of saltpetre at 5° . 2	3		(*)	25	264
13	Lime the same . . 1 Dust of same clay with 1-2 of solution of saltpetre at 10° 2	3			25	242
14	Lime the same . . 1 Dust of same clay with 1-2 of solution of com. salt at 5° . 2	3	15	330	25	264

Observations on the experiments of Table No. XXIII.

To make the above experiments I took Holsheim clay and mixed it with various quantities of solutions of soda standing at 5° of the *pèse acid.* The quantities of solutions of soda that the clays contain are taken with reference to the volume of clay. I did the same with potash, as is shown in the numbers from 7 to 11. Nos. 12 and 13 have the clay mixed with water containing saltpetre; and No. 14 has the clay wet with salt water.

The clays of the first eleven numbers of the first column of the table were heated in a lime kiln, between the tiles and the bricks, so as to give them only a moderate heat. Those of No. 1, 6 and 11 of the second column were burned with the lime, and subjected to a very high heat.

If the result of the first eleven numbers, wherein the clay was heated with bricks, be observed, it will be seen that the first of those which con-

*This mortar broke, on being cut, but was very hard. Au.

tain soda, differ but little from No 1 which contains none, but that the resistances, in the succeding numbers, go on diminishing a little, as the proportion of soda was increased. With potash, I obtained a different result; the resistance of the mortars augmented up to No. 9, and afterward diminished. The clays placed between the tiles and the bricks received a degree of heat rather too slight—for No. 1 supported a weight of only 330 lbs, while we have seen that this clay could sustain a weight of 396 lbs, when the clay had been properly calcined.

The clays No. 1, 6 and 11, which had been placed in the middle of the lime, received a much higher degree of heat than ordinary: for the cement No. 1 had become of a slate blue, while it is commonly of a liver colour (*d'un rouge foncé*) a good deal like the puzzalona that I used.

We see that mortar No. 1 lost much of its strength when its cement had been calcined with the lime, since, instead of 330 lbs, it supported only 99 lbs: but it is singular that Nos. 6 and 11 which had received the same degree of heat, and of which the cements were equally blue, offered a resistance much greater than the corresponding one of No. 1. The effect of soda and potash, then, has been to prevent this clay from losing a great part of its hydraulic property in consequence of a too high calcination. I thought I should obtain an opposite result, because these substances, heated with silex, form glass, and all vitrified substances make very bad puzzalonas. But these gave no trace of vitrification. I obtained a slight advantage by moistening the clay with the lye of ashes standing at 5°.

No. 12 and 13 are composed of the same clay tempered with water containing saltpetre (nitrate of potash.) This trial was made in duplicate; the cement in one being but little, and in the other, much burnt. Unfortunately the first mortar broke on being cut to the proper size; the second experiment gave a good result, like that obtained from potash. This trial was designed to ascertain whether the *aqua-fortis cement*, which has been a long time in use, merits its high reputation. This cement is an argillaceous residue, derived from distillation of nitrate of potash and clay, to extract nitric acid. This operation is performed in matrasses of stoneware or glass: the residue being a combination of ferruginous clay, potash and some alkaline salts. Being pulverized, this is what is called *aqua-fortis cement (le ciment a l'eau-forte.)* Very good results are got from it. But I presume, after what has been shown above, that the quality of the cement must be very variable, according to the composition of the clays used, and especially, as they may sometimes contain lime. It is unfortunate that the mortar No. 12, of which the clay had been moderately calcined, was broken. We see that the trial, in the case where the clay had been highly calcined, gave an average result. No. 13 only differed from No. 12, in being mixed with water more highly charged with nitrate of potash. The experiment of No. 13 having given a result sensibly superior to the No. 1 corresponding, I am induced to think that the *aqua-fortis cement* may be very good; but these experiments should be repeated.

I have stated above that the Dutch make a very good factitious trass, by calcining a clay which they extract from the bottom of the sea; I, consesequently, made No. 14, of the Holshiem clay, and salt water. If we compare No. 14 of the first column and the corresponding No. 1, we see that the result is the same. If we make the same comparison in the second column, which comprises the clays calcined with the lime, we shall remark that the clay mixed with salt water has a great superiority. We have a right to conclude then that the marine salt acted like the potash and soda—

that is to say, it prevented a high degree of calcination from depriving the clay of a great portion of its hydraulic property. It results from this, that when fabricating artificial puzzalonas near the sea, it will be proper to try whether, on mixing the clays with salt water, the bad effects of too high a heat will be prevented. This would be advantageous, because it is difficult to give an equal degree of heat to a kiln, when the temperature is high. These experiments should be made at different degrees of temperature, so as to compare results. Even in the interior of the country, it would not be expensive to add salt to the clays which are to be calcined—using a solution of common salt.

Although, according to table No. XXIII, soda, mixed with Holsheim clay, gave results a little inferior to those given by the natural clay, it was not so with potash. When the proportions were not too great, potash gave results sensibly better. This resort cannot always be had, because of the cost of the materials, and of the operation of mixing. I shall show in the sequel that it is easy to arrive at the same end in a less expensive mode, by choosing proper clays; but the observation of the effects of potash will serve to throw some light on the theory of puzzalona and trass.

The hardening of the mortars in the above table was rather slow; one of the causes was, that the experiments were made in the beginning of winter. The mortars of the first series all took about fifteen days to harden, and those of the second, twenty-five days.

I now proceed to give the results obtained with the dust of clays found near Strasburg, or carried thither for various uses.

Table No. XXIV.

No. of the mortar.	Composition of the mortars.	No. of days required to harden in water.	Weight supported before breaking.
		Days.	lbs. lbs.
1	Fat lime, sand and trass	4 to 20	231 to 510
2	Do. and Trass	3 to 16	264 to 583
3	Fat lime, sand and puzzalona	4 to 5	352 to 499
4	Do. and puzzalona	3 to 5	286 to 550
5	Do. sand, and dust of Frankfort clay	4 to 6	418 to 561
6	Do. and dust of Frankfort clay	3 to 5	422 to 578
7	Do. sand, and dust of Cologne clay	14 to 18	286 to 473
8	Do. and dust of Cologne clay	12 to 15	308 to 495
9	Do. sand, and Dust of Wissemburg clay	14 to 16	242 to 429
10	Do. and dust of Wissemburg clay	12 to 15	220 to 462
11	Do. sand, and dust of Holsheim clay	12 to 18	253 to 418
12	Do. and dust of Holsheim clay	10 to 15	275 to 440
13	Do. sand, and brick dust of Sufflenheim	16 to 20	231 to 407
14	Do. and brick dust of Sufflenheim	15 to 18	253 to 462
15	Do. sand, and dust of Kilbsheim clay	10 to 12	231 to 308
16	Do. and dust of Kilbsheim clay	8 to 10	253 to 319
17	Do. and dust of whitish bricks of Ackenheim	12 to 15	242 to 286
18	Do. and dust of red bricks of Ackenheim	25 to 35	77 to 121
19	Do. and dust of yellow bricks of Kehl	25 to 40	55 to 77
20	Do. and several kinds of dust from Depot	10 to 30	121 to 330
21	Do. and slate dust	12 to 15	319 to 451
22	Do. and "*ciment de sanguine*"	15	352
23	Do. and dust of yellow ochre	18	297
24	Do. and two parts of Paris cement	4	187*
25	Do. sand, and Paris cement	5	99*

*These two mortars were cracked.

Observations on the experiments of Table No. XXIV.

I have united in the above table several trials to produce hydraulic mortar with fat lime and different kinds of clay calcined, without adding any thing to them. At the top of the table, I put the results obtained with trass and puzzalona. I have united all the experiments of the same kind in a single statement, because I sometimes made the mortars by taking the lime in a powder, and sometimes in paste. The proportions of sand, trass and cement, also varied. We see that it would have required a very extended table to separate all these experiments. By uniting them, as I have done, the general result may be seen.

No. 1 comprises mortars composed of various fat limes, sand and trass; several causes contributed to vary the hardening and the resistance: these are, principally, the quality of the trass; the time it was left in the air after being slaked with a little water; the proportion, and, lastly, the season of the year. This observation applies to all the following mortars. The weakest resistance of the mortars No. 1, is 231 lbs., and the strongest 510 lbs.

No. 2 comprises a series of experiments made with fat lime and trass, without sand, the resistance varied from 264 to 583 lbs.; this last result is the greatest that I obtained in all my experiments. This mortar was made in summer, with lime that had been slaked to powder for two months; it is probable that the piece of trass was of an unusually good quality.

The two series of experiments under Nos. 3 and 4, were made with fat lime, sand and puzzalona; and with lime and this last substance without sand. The puzzalona behaved like the trass. From the column showing the hardness, it might be supposed that the puzzalona mortars hardened quicker than those made of trass, but it is not so. In the instances of the trass, the mortars were made in winter as well as in summer; but with the puzzalona, the experiments were made only in summer, and during that season, the hardening was about the same for the two substances. There is, however, a light advantage in favor of puzzalona, but which cannot be estimated at more than half a day. I therefore, as stated above, regard these two substances as having given me like results.

Nos. 5 and 6, comprise experiments made with clay brought from a village called Kinglesburg, twelve leagues from Frankfort; this clay is used at Strasburg to make alum; it is preferred to the clays of the vicinity because it contains almost no iron; they calcine it for thirty-six hours before dissolving it in sulphuric acid. When this clay is in its crude state, it is blackish, owing to vegetable remains. By calcining it a little, it becomes blue; in which state it gives bad results; when strongly calcined, it becomes very white, and forms an excellent artificial puzzalona, as appears from those two numbers, 5 and 6. The analysis of this clay shows that it contains no lime, and the iron found in it in small quantity may be considered as without action. It has been an error, therefore, to attribute great influence to iron in the improvement of artificial puzzalonas: these experiments, 5 and 6, showing that a very good artificial puzzalona may be obtained from a clay containing neither iron nor lime. The analysis of this clay exhibits the alumine as existing in the proportion to the silex, of about three to five, (see vol. xx, p. 378:) it is very greasy to the touch. Mortars made of this cement and sand, sometimes gave superior results to those in which there was no sand, and sometimes inferior, as happened with trass. The hardening was always as quick as with puzzalona; which I shall explain in the sequel.

The series Nos. 7 and 8, were made of the white clay which is brought from Cologne to Strasburg to make pipes. We see, at page 378, vol. xx, that it contains no lime and very little iron. The table shows that the mortar made of this cement gave very good results also, although the clay does not contain as much alumine as that from Frankfort; the hardening was slower.

The mortars Nos. 9 and 10, were composed of clay from the environs of Wissemburg; it is used at Strasburg to make common pipes. This clay contains no lime; it is, as it were, marbled with veins of red oxide of iron; the analysis indicates but little more iron than the Cologne clay, but it is because the specimen analysed was taken from between the veins. The table shows the results to have been very good.

The series Nos. 11 and 12, were made of Holsheim clay; which contains no lime, but a quantity of iron; it is of a reddish color, and quite greasy to the touch, although the proportion of alumine to the silex is hardly one to four. The dust of this clay gave very good results, but the hardening was slow.

The series Nos. 13 and 14, were made of bricks of Sufflenheim, of which the clay contains no lime, but a considerable quantity of iron; it is not very greasy, and, indeed, the alumine is only about one seventh of the silex. The cement of which I made the several mortars, were made from bricks which I reduced to powder; we see that these results are also very good.

The series Nos. 15 and 16, were made of Kolbsheim bricks; the clay of this kiln is quite greasy—containing one of alumine to four of silex. It contains a considerable quantity of iron, and more than one tenth of lime; the results were not so good as with Holsheim and Sufflenheim cements. The trials were made with brick dust; I did not make many, and it is possible that I used bricks that had been too much burned.

Nos. 17 and 18 were made of the dust of Achenheim bricks. No. 17, of the dust of a whitish brick, containing but little iron and little lime. The results were pretty good. No. 18 was made of the dust of bricks which are very red—containing much iron, and a great quantity of lime. The mortars of this cement were very bad. I am not certain whether the bricks of No. 17 were made of clay from Achenheim itself, or its environs.

The experiments under No. 19, were made with yellow bricks from Khel. I do not know the analysis of this earth, but it is a yellow ochreous earth, containing a considerable quantity of lime; we see that I got bad results, only.

The series No. 20, was made with various cements taken from the place of deposit of a contractor—being derived from a mixture of various tiles and bricks. We see that I had sometimes good results, and sometimes quite bad; as might be expected from the manner in which the cements were composed.

The experiments under No. 21, were made of slates from the neighborhood of Mayence. I do not know the analysis, but being assured that they contain little or no lime, I calcined them highly, and they gave me a very good cement. I had occasion to notice that, to obtain a good result, it was necessary to calcine these slates until they began to take a light red color on cooling, which requires quite a high heat. I am surprised that in the experiments of Mr. Gratien, senior, at Cherbough, better results were not obtained; this appears to me to have been owing to the degree of burning, which they did not sufficiently vary, to ascertain the best. I presume that good cements could be made of the tender strata found near the surface of the slate quarries, and which are too tender to be formed into slates. They will be easier to reduce to powder after calcination.

No. 22 was made of a cement obtained from a substance known under the name of "*sanguine*;" the resistance of this mortar was quite good.

Mortar No. 23 was made of cement resulting from the calcination of a clay known by the name of yellow ochre; the result was less than that of the preceding mortar. It appears to me that the yellow ochreous clays are not so good as others for the production of artificial puzzalonas; it is possible it may be owing to the oxide of iron being found therein in combination with the silex, as shown by Berzelius.

In the *Annales de Chimie* of 1824, it is stated that in 1823, Mr. Saint Leger made factitious puzzalona at Paris from the clay of Passy and Meudon, in the proportion of three parts of these clays to one of lime slaked and measured in paste. In 1825, I made two mortars of some cement given me by Mr. Saint Leger. Mortar No. 24 is an experiment therewith; it was made of one part of fat lime measured in paste, mixed with two parts of this cement: this mortar hardened promptly. At the end of a year, I submitted it to rupture, with the others; but it was cracked, and supported only 187 lbs.

No. 25, was made of the same lime, of sand, and of cement, in equal parts; this mortar hardens promptly; but it, also, was cracked, and bore only the light weight of 99 lbs. We shall see, in the second section, that I made of this cement a mortar which was exposed in the air for one year, and that it had so little consistence, that it crumbled easily in the fingers.

The bad results that I obtained from the cements of Mr. Saint Leger seem to be due to the quantity of lime which they mix with the clay in making the cement. I said in my memoir of 1822, of which an extract is contained in the Moniteur of January 22, 1823. "The substance of which it is most important to observe the proportions, is lime. If the argillaceous earth used contains a tenth, or more, of lime, and it be heated to the degree necessary to burn bricks properly, the trass obtained will be very bad; if this earth be heated to the degree employed to burn those bricks which are called *light burned bricks*, the trass will be of a mediocre quality only, but may be used in works not requiring prompt induration. It appears that a very small quantity of lime, as four or five per cent, in the clayey earths, far from injuring the quality of the puzzalona or trass, brings, on the contrary, the clay to that condition that the cement produced will cause the mortar to harden very promptly, and at the same time impart to it a high degree of force. When there is no lime in clay, a higher burning is required and the hardening is rather slower."

In 1822, therefore, I regarded lime as a substance to which the greatest attention should be paid, when it was found to be a natural constituent of the clays to be turned into puzzalonas; but that I considered it rather to be avoided than sought after; observing, nevertheless, that a small percentage of this substance was rather useful than injurious, with proper care in managing the heat. The expense of mixing lime with clays that are to be converted into puzzalonas, should, therefore, be avoided.

On mixing fat lime slaked to paste, with clay, I have observed a singular phenomenon, for which I have not been able to account: it is this, if clay be diffused through water, till we bring it to the consistence of clear sirup, and, after having brought the lime to the same state, the two mortars be mixed together, as soon as the mixture is made, it becomes so thick that it will be difficult to continue the operation without adding a considerable quantity of water. I do not know to what this is owing.

The results of experiments 18, 19 and 20, show how dangerous it would

be to use, without examination, the first cements encountered. I will cite an example in point. When Marshal Vauban built the citadel of Strasburg, three great casemates were constructed in each of the two bastions which lie on the town side. The casemates of the right bastion are very dry, and they are often used as powder magazines. The casemates on the left were, on the contrary, very wet; the water filtered, every where, through the arches; all the casemates had caps of cement, but those of the right had been made of good, and those of the left, of bad cement. In 1808, they were obliged to make the caps of the casemates on the left anew. On breaking up the old caps, it appeared that they had been made of cement, (brick dust?) but that moisture had penetrated for a long time, and that several parts had scaled off. In the report on the reconstruction, it is said, "We followed vigorously, in the execution of this work, the method indicated by Mr. Fleuret. The cement was made under the supervision of a workman employed by him, and it was put on by masons practised in this kind of work. The thickness of the cap was two and four-tenth inches, and was composed of three layers of cement, applied successively with the trowel, and compacted by ramming. The last course was rammed, and afterwards polished off with a stone, until the cement had acquired such hardness as to receive no further impression." (Report of Captain Gleizes of the Engineers, January 30, 1808.)

We see that it was no want of precautions that caused the work to fail. Notwithstanding these precautions, the water, after ten years, filtered through every part of these arches, and they were again, necessarily, remade. On demolishing them a second time, it was observed that several portions of the three layers of mortar that had been successively placed to form the caps, had no connexion with each other. I think it is a great fault to make the caps of arches in successive layers; they should, in my opinion, be made of a single one, let the thickness be what it may. Mr. Fleuret attaches great importance to beating mortars well, and we shall see further on, that this is also an error. The caps at Strasburg failed the second time because they used fat lime, and brick dust? taken at hazard; it was found to have no hydraulic property, and the mortar had no consistence. Mr. Fleuret succeeded very well in making factitious stones, and water pipes, when he used the Metz lime; but a contractor at Phalsbourg who attempted to apply this process to the construction of the military fountain—using the materials of the country, failed in his work, and was ruined. At Landau, also, the caps of arches made according to the process of Mr. Fleuret, failed. The caps of the above casemates of Strasburg were constructed in 1819, with good materials: they succeeded well, and the casemates have become very dry. I thought it my duty to give these details to show how important it is not to use cements without a previous trial, because it is always an expensive substance, and if badly chosen, it may happen that the result is no better than if so much sand had been used instead thereof.

I am now about to state how I detected an important action exercised by the air in perfecting artificial puzzalonas. We may remark that all the experiments made with Frankfort clay, hardened very quickly, and gave great resistance. I took these clays from a certain furnace where they had been calcined for the purpose of making alum. Having, one day, burnt in a lime kiln, some bricks made of this clay, I was surprised to see that the hardening was much slower, although the degree of heat had been about the proper degree, as was easy to perceive by the color. Examining

the construction of the two furnaces, I remarked that the bricks were burnt by being placed above the lime; that above the bricks tiles were placed, and, lastly, above all, pieces of burnt clay covered with fragments in such a way as to leave openings only in certain places, thereby directing currents of air into certain parts only of the kiln. It resulted from this arrangement, made with a view to save as much heat as possible, that only certain bricks and tiles were exposed, during calcination, to a current of air. I will remark, that the dust of these bricks always caused the mortars to harden more promptly than the others. On the other hand, I noticed that the hearth of the alum furnace was pierced with many holes, which caused a strong current of air throughout all the mass of clay submitted to calcination. Pl. I, Fig. 2, gives a plan and section of this furnace. The calcination is effected by wood placed in the lower arches. It then occurred to me that the reason why I obtained good results with this clay, and especially a rapid induration, might be, that at a high temperature the hydrate of alumine might absorb oxygen. I was led to this supposition because I had ascertained, page 318, vol. xx, that the hydrate of lime absorbed oxygen. I calcined a little clay in a current of air, and also a little in a close vessel, and I ascertained that the alumine that had been calcined in a current of air dissolved in sulphuric acid more easily than the other. This was a presumption for my hypothesis, but no proof. I had, likewise, heated in these two ways, a little alumine extracted from alum, and had made mortars by mixing it with lime from white marble. The mortar made of alumine burned in a current of air appeared to me to take consistence sooner than the other; but, after some time, both were equally soft, and at the end of a year had no consistence. This experiment seems to prove that alumine alone will not form puzzalona, and that it requires to be mixed with a certain quantity of silex; this result is besides in accordance with table No. XXII, in which we see that by taking away from clay too much sand, the energy of the cement was diminished, and that it was augmented on adding very fine siliceous sand. The alumine which I used having already been calcined and dissolved in sulphuric acid, to form alum, it is possible that this had taken from it the property of forming puzzalona, and the experiment should have been made with natural alumine; but this substance is very rare, and I had none at command. After these first essays, I made the last four experiments of table No. XX. We have seen that the hardening was very prompt; which was owing, as I said in speaking of those experiments, to the bricks being exposed to a current of air during the calcination. The bad mortar—the cement having been properly burned, gave a good resistance, and at the same time a very prompt induration. I then made the following experiments: I took Holsheim clay, of which I made two bricks; one of these bricks was of the natural clay, the other was of the natural clay mixed with 0.02 of lime in paste. I calcined these two bricks in a lime kiln, placing them where, as it seemed to me, they would be but little exposed to the current of air. I, at the same time, made balls of the size of a nut, of the same Holsheim clay, both in its natural state, and also mixed with 0.02 of lime, and afterward calcined these two kinds of balls in a reverberatory furnace, keeping them red during six hours, in a hessian crucible having a hole in the bottom. These last clays were, therefore, calcined in a current of air, and the former, not. The following results were obtained. The mortar of the natural clay heated in the lime kiln did not harden till the end of thirty days, and supported a weight of 385 lbs. before breaking; that which was made of the

same clay mixed with 0.02 of lime, hardened in seventeen days, and broke under a weight of 352 lbs. The mortar made of the natural clay that had been heated for six hours in a current of air, hardened in five days; but it broke under a weight of 330 lbs. Lastly, the mortar made of the clay which contained 0.02 of lime, and which was, also, heated for the same time in a current of air, hardened in three days; but this mortar was cracked, and broke under a weight of 198 lbs. These experiments were made in the beginning of 1825.

Having communicated these results to Mr. Bergère, *chef de bataillon*, of the engineers, he informed me that Mr. Raucourt, engineer of roads and bridges, had published at Petersburg, in 1822, a memoir in which he mentioned the influence of air on the calcination of clays that are to be transformed into puzzalonas. I procured this work, and quote the following remarks from page 130. "I had thought for a long time that the degree of calcination could not be the only cause of the superior qualities that argillaceous earths acquire by a few minutes' torrefaction: if it were otherwise, slightly burned bricks would furnish excellent puzzalonas, which is far from being the case, and several essays made with pounded bricks, burnt with various degrees of intensity, gave me no result comparable to that given by clay exposed on a red hot plate.

"It was thence inferred that the contact of air is necessary to modify, in the most favorable manner, the oxides which the earths contain, so that they may form good hydraulic combinations with lime. To assure myself more completely, I made direct experiments which fully confirmed this induction, and which led me to more particular researches than had before been made on factitious hydraulic lime."

The experiments of table No. XVI show, in opposition to the opinion of Mr. Raucourt, that lightly burned bricks may furnish very good puzzalonas, when they contain lime, and the burning has been properly managed. This engineer asserts positively, in this quotation, the necessity of contact of air to modify the clays advantageously; but he reports none of the experiments that he announces as having made.

At page 135 of his memoir he says:

"If it be true, as is said, that the earths are metallic oxides, one might be led to think that they have need of a certain degree of burning in contact with the air, to form with lime, and the concurrence of water, insoluble compounds; and as several chemists have already shown that the presence of silex in the state of gelly will contribute to render a fat lime hydraulic, that it is the same with the oxides of iron and magnesia; that Mr. Vicat, by his transformations with clay, proves that alumine, also, might enjoy this property; that if the very hydraulic lime I H (Art. 163) be observed, it will be allowed that magnesia must necessarily fulfil analogous functions; one would be almost convinced that all the metallic oxides, properly prepared with fire, would form, with lime, combinations susceptible of hardening in water."

There are many errors in this passage; for it is demonstrated that iron and manganese act no part in hydraulic limes; and what Mr. Raucourt says in this particular, proves that he has not consulted experience. Nothing has proved, as yet, that alumine, or magnesia, possesses the property of forming hydraulic lime. (The lime cited art. 163, contains clay.) Lastly, nothing is more doubtful than such properties as Mr. Raucourt has attributed to almost all metallic oxides. In a matter so delicate as this, the imagination must not get in advance of facts.

As Mr. Raucourt has not given the experiments which led him to the opinion that the air acts an important part in perfecting artificial puzzalonas, I am obliged to draw my conclusions from the facts presented in my preceding table, and principally from the last four experiments reported in page 24. There are two things to consider in artificial puzzalona; the first, is the promptitude of induration of the mortars whereof they form part; the second, is the resistance of these mortars. The experiments at the end of table No. XX, the observations I made on Nos. 5 and 6, of table No. XXIV, and the few experiments cited in page 24, prove that when these clays are calcined in a current of air, they harden much the more promptly. But is the resistance of the mortars greater, also? I cannot affirm positively that it is.

We see, for example, in the four experiments cited, that the case of the most prompt hardening, coincides with the weakest resistance; but we ought not to conclude from thence, in a positive manner, that the calcination in a current of air diminishes the resistance at the same time that it increases the promptitude to harden; because the result obtained may have depended on some other cause—as, for instance, the degree of calcination. What induces me to think that calcination of clays in a current of air, far from diminishing the resistance of mortars, will, on the contrary, augment it, is, that all the clays Nos. 5 and 6, of table No. XXIV, having been heated in this manner, the hardening was very prompt, at the same time that the resistances were very great. I cannot positively affirm that this last effect will follow, but I think it probable. I have not had time to make the direct experiments that I intended, in order to clear up this point.

In a note printed by me in 1825, I stated that I was induced to think that at an elevated temperature, the alumine contained in clays absorbed oxygen, and that this absorption rendered cements more proper to combine with fat lime in the moist way. Mr. Vicat is of a different opinion. He inserted a note in the *Annales de Chimie*, of 1827, Vol. XXXIV, wherein he says that he calcined, for half an hour, pulverised clay in close vessels, and that he heated the same quantity, during five minutes, on a metallic plate kept at a common red heat. After cooling, the substances were weighed, and were found to weigh nearly the same. Mr. Vicat concludes from the small differences found between the weights of clays calcined in close vessels, and those calcined in the air, that there is, incontestably, no absorption.

I will remark, that nothing can be concluded from this experiment. A part of the clay was calcined during half an hour, and the other part during five minutes only; the quantities of water lost by these two portions could not, therefore, have been the same, since they were not equally heated. It is, besides, possible that a small quantity of oxygen, difficult to appreciate with a balance, might suffice to give new properties to the clay. To know whether alumine absorbs oxygen, it would be necessary to heat it highly in a tube not susceptible of oxidation, and to pass, during the calcination, at different times, a given volume of oxygen gas, over the incandescent alumine, and, afterward, to measure the volume of gas, in order to ascertain whether it had been diminished. I had not under my control the means necessary for making this experiment; the observation that I made, that alumine calcined in a current of air, dissolved more easily in sulphuric acid than when calcined in a close vessel, led me to think there was an absorption of oxygen, but it is no proof; I offer it as a presumption only.

Several Engineers have proclaimed the good results obtained with ashes

derived from the combustion of coal in furnaces, or lime kilns; others on the contrary, have denied the effect of this substance. With this question, it is the same, I am satisfied, as with the question whether dust of tiles or bricks, much, or little burned, should be taken. The good results of the Tournay ashes* have been known for a long time, and are contested by no one. Having been employed at Lille, in 1815 and 1816, I had an opportunity of knowing the good effects. But when I wished to use, in the same way, the coal ashes at Strasburg, I could not obtain a good result. I made mortars composed of one part of fat lime measured in paste, and two parts of coal ashes: after an immersion of a year, these mortars were as soft as if made of sand. These opposite effects surprised me, and on examining different coals and their analyses, I saw that several of them contained quite a quantity of clay, while others contained little or none. But coals are generally burned on a grate: the clay they contain is thus calcined in a current of air; and it is the mixture of this clay with a little iron, constituting the residue, that is used, when we take these ashes: we see, therefore, that it is a real puzzalona that they have been making, for a long time, without knowing it. Should the coal contain no clay, or should the clay be mixed with too much lime; in the first case no result will be got; and in the second, if the calcination has been too high, the ashes will possess but an indifferent quality.

I think Mr. Sganzin is wrong when he says in his *cours de construction*, page 32, "Experience teaches that the ashes of all coals which have served for the calcination of lime, will form a mortar hardening promptly in water." We know that when lime is calcined with coal, the ashes of the combustible is mixed with a considerable quantity of particles of lime. Although the coal should contain no clay, if the lime calcined be very hydraulic, I conceive that a mortar of fat lime and these ashes would harden in water; but the result would be due to the presence of the hydraulic lime; I think that no result would be obtained if, with such coal, the calcination were of fat lime.

In 1826, I was charged with the inspection of several places along the Straits of Calais. Much coal is used in these departments. At Boulogne where the forts of the sea coast were to be repaired, I requested Capt. Le Marchand of the Engineers, to make some experiments with cements and the coal ashes of the neighbourhood, because the use of the Boulogne pebbles, before mentioned, was very expensive, and it was difficult to obtain them in quantity. This Engineer took great pains in his researches, and informed me that he had obtained good results with some cements, and especially with the ashes got from the coal burned in several manufactures in Boulogne. He procured the analysis of this coal, which is composed of the following substances; combustible matter, 96.62; alumine, 2.00; silex and iron, 1.38. Therefore the ashes he used were nothing else than a very aluminous clay, which contained no lime, and which had been calcined in a current of air during the combustion of the coal, and it is not astonishing that it gave very good mortar. The cinders of forges, another residue of the combustion of coal, may be assimilated to ashes: there are some that give very good, and others that yield no results: neither should, in any case,

*Rondelet, in his *art de batie* thus describes this substance. "This powder is made of half burned fragments of a very hard blue lime-stone. These fragments fall, during the burning, through the grate of the lime kilns, and are mixed with the ashes of the coal. The Tournay ashes are considered equal to the Dutch trass, and are used for the same purposes." Tr.

be employed without our being assured of their quality. To know if they may be used with advantage, the practical process for distinguishing good cements from those that have no hydraulic property, that I will soon point out, should be followed.

I commenced my experiments on artificial puzzalonas in 1821; and the first operation I performed was to see whether I could make puzzalona and trass anew out of their constituents. I accordingly took the substances contained in trass and puzzalona, according to the old analysis which is given in Vol. XX, p. 391; with these I made a paste with water; afterward, I calcined the mixture at a low red heat for six hours; and, lastly, reduced it to very fine powder. As I had no natural alumine at my command, and as I doubted the efficacy of that to be obtained from the decomposition of alum, I took the Cologne pipe clay, washed it several times with a great deal of water, and decanted, to separate the greater part of the sand from the alumine. I assured myself, by calcining a small portion of this earth, and dissolving it in sulphuric acid, that it contained hardly any silex. This is the substance to which I added the other matters in the proportions given in the old analysis. We see then that, by this operation, my artificial trass and puzzalona had a little more silex than the natural productions, by the quantity retained in the aluminous earth; but this augmentation of silex was the same for both mixtures. I made two mortars by taking one part of Obernai lime, and two parts of each of these compounds: the mortar of the factitious trass hardened in four days, and broke under the weight of 385 lbs: that made of the artificial puzzalona hardened in three days and supported 477 lbs. before breaking. The lime was the same in both experiments: all other circumstances were alike: wherefore we must attribute the superiority of the artificial puzzalona over the artificial trass, to the clay of the first mixture containing much more alumine than the second. I was wrong in using hydraulic lime: I should have used fat lime, which I, afterward, always used when I wished to determine the quality of puzzalonas or other analagous substances. This experiment, and those which were made of the very aluminous clays of Frankfort and Cologne, prove that results, exactly like those furnished by natural puzzalona, are obtained, by suitably calcining greasy clays.

I was not able to determine the proportion in which the silex and alumine should exist to give the best results; but I am led to think that the alumine should equal, at least, a third of the silex. We have seen, however, that the Sufflenheim clay, which contains seven parts of silex to one of alumine, sometimes produced very good cements; but it is probable the best were obtained with portions of clays more aluminous than the others. The results contained in table No. XXII support this opinion. It is true we might be inclined to infer the contrary from the new analysis of trass and puzzalona made by Mr. Berthier, and given in Vol. XX, p. 391. The proportion of alumine is about the same in Trass and Puzzalona, according to Mr. Berthier, and is much smaller than according to the older analysis: but the analysis of a single specimen must not fix the proportions of a substance which gives, as we have seen, very various results; and every thing leads to the belief that the several pieces of trass and puzzalona vary much in their composition. It is possible that the specimens of trass and puzzalona that I sent to Mr. Berthier, were possessed of a high degree of energy, although containing but little alumine, by reason of the potash they contained; for this substance augments, in a sensible manner, the energy of puzzalonas, as we have seen in the experiments of table No. XXIII. But

the good results obtained from the calcination of greasy clays, prove that cements without potash, may be made to be quite equal to trass and puzzalona.

The experiments above show that, with artificial puzzalona and fat lime I have obtained mortars much superior to those made with artificial, or even natural, hydraulic lime, and sand. Although I happened, with some pieces of Obernai lime, to obtain results approaching those afforded by artificial puzzalona, such instances are rare; and, in cases like these, it is the general bearing of the facts that we are to regard. I announced these results in a little pamphlet published in 1824, and I stated, moreover, that there would accrue a sensible economy. Mr. Vicat, in a criticism on this pamphlet has endeavoured to prove the contrary; but it will not be difficult to show that he was deceived in his calculations. This Engineer says "The objection of Mr. Treussart to the high price of artificial limes is without foundation. In fact the trass mortars are as follows:

For two cubic metres of trass (70.68 cub. feet) *a* \$5.22½ .	\$10.45
For one cub. metre (35.34 cub. ft.) of fat lime in paste . .	2.28
	\$12..73

"The three cubic metres of materials are reduced by the mixture to 2.30m; it follows that the cubic metre costs \$5.53 (35.34 cub. ft. cost \$5.53 equal \$0.16 per cub. foot.)

On the other hand to make a cubic metre of hydraulic lime mortar, requires 0.90m of common sand *a* \$0.28½	\$0.26
0.43m of hydraulic lime in stiff paste, which at the mean price will cost (one foot cost \$0.34) . .	5.27
	\$5.53

The prices then will be exactly the same, since in each case it is found to be \$5.53: but let us see if the basis of this calculation is exact. I will first remark, what I did not neglect to state in my pamphlet of 1824, namely that the mortars of fat lime, sand and trass, gave me results which were often superior to those in which there was trass without sand; and that it was the same with mortars made of puzzalona. We may satisfy ourselves by table No. XIII that when the mortars of trass and puzzalona, alone, were superior to those containing sand, the advantage was not sufficient to lead to a preference of the former. I obtained a like result with artificial puzzalona of table No. XXIV. It is, therefore, an error of Mr. Vicat's to compare the price of mortars made of artificial hydraulic lime, with that made of fat lime and trass without sand: it is necessary to compare it with mortar made of lime, sand and trass. If the first calculation, above, be thus rectified, the price of \$10.45, given by two cubic metres of trass at \$5.22½, will be reduced to \$5.51, resulting from one cub. metre of sand at \$0.28½, and one cub. metre of trass at \$5.22½: consequently the cubic metre of mortar composed of fat lime, sand and trass, will amount to \$3.39=\$0.10 per cub. foot, only, instead of \$5.53. The objection that I made, therefore, is not, as Mr. Vicat thought, without foundation. I feel bound to state that the prices I have given, using the data established by Mr. Vicat, appear to me to be too low for the principal places in France; but I was obliged to use the elements he had employed.

It is possible that in countries where chalk is abundant it will not cost more to make hydraulic mortar with artificial hydraulic lime and sand,

than with fat lime, sand and factitious trass: but in many countries chalk is not to be procured; and then it will be necessary to mix fat lime with clay, and to give a second burning for the mixtures; which will cause embarrassment, and an augmentation of expense. I am convinced that, in such cases, there will generally be economy in making hydraulic mortar at once of fat lime, sand and artificial trass: and besides the relation of the resistance of these two kinds of mortar, is no important consideration. If we compare the results obtained in all the preceding tables, we shall see that the mortars made of sand and hydraulic lime, whether natural or artificial, afford an average resistance hardly amounting to 220 lbs., while it is 352 lbs. for the mortars made of fat lime, sand and natural or artificial trass. To compare the expense justly, therefore, it would be necessary to lessen the preparation of trass, substituting sand, until we arrived at an equal resistance.

I must, besides, observe that we are much more certain to obtain uniform results with hydraulic mortars, composed of fat lime, sand and factitious trass, than with those that can be made of artificial, or natural hydraulic lime, and sand only. We have seen, in fact, that hydraulic limes deteriorate when a little too highly calcined; it is necessary to keep them carefully from the rain; and they, in general, lose a great part of their hydraulic property, unless used soon after leaving the kiln; which often occasions embarrassment. With fat lime and factitious trass, all these difficulties are avoided; because the lime loses nothing by being a little more calcined than necessary. It is not necessary to use it immediately, nor to take any troublesome precautions. As to factitious trass, once prepared, it needs no particular care: for neither the influence of the air, nor humidity, will deprive it of any of its properties.

It results from what I have said that, in a country where there are good natural hydraulic limes, they should be used in preference to fat lime, which requires, always, to be mixed with natural or artificial trass, for constructions in water or in damp places. There will be economy, and no bad results to fear, in taking the precautions I have pointed out. When, however, works demanding great care, are to be made, such as floors of Locks, caps of Arches, &c., I think it will be proper to add to the mortar a little natural or artificial trass. The proportion to be added depends on the quality of the hydraulic lime and of the trass. If both are of good quality, and if it be known, for example, that the lime will bear two and a half parts of sand, then the mortar may be composed of one part of this lime, two parts of sand, and half a part of factitious trass. This small quantity of trass will not much augment the expense, and will always correct the bad effects resulting from portions of the lime having been too much burned, or impaired by exposure to the air. The further the hydraulic limes are from the qualities I have above supposed, the greater should be the proportions of natural or artificial trass.

The question, however, is, to know what should be done in a country where there is no hydraulic lime, or where it is of an inferior quality. It is on this point that I differ entirely from Mr. Vicat. This engineer contends that it is best to make factitious hydraulic cement by the process he points out; while I think there will, in general, be more economy, and better and more uniform results, by making hydraulic mortars at once from fat lime, sand, and artificial trass. It appears to me that the general bearing of the very numerous experiments I have presented, leaves no room to doubt as to this matter.

I will add, that, from time immemorial, in countries affording natural hy-

draulic limes, they have been used with great advantage. Wherever they were not to be had, hydraulic mortars were made, directly, of fat lime and cement. I have, several times, had occasion to demolish works in water, of which the mortars had been made in this manner. It appears then, that, in fact, I only propose to continue a method long in use, with this difference, that in lieu of using every kind of cement indiscriminately, I give the means of distinguishing the good from the bad, and of making such as will give results equal to those furnished by natural puzzalona or trass.

To ascertain which are proper cements to produce good hydraulic mortars, on being mixed with fat lime, the following means may be used. From a neighbouring brick kiln three bricks should be taken, one of which should be a lightly burned brick; another should be chosen from those which are considered to be burned in the best manner; and a third from those too much burned, but not vitrified in any degree. The brickmakers know well how to distinguish them by the sound and the colour. A fragment of each of these bricks should be separately reduced to a very fine powder, and passed through a very fine wire seive. The finer the dust, the better; in taking it between the fingers no grains should be felt, and it should be soft to the touch. Fat lime which has been reduced to paste for some time, should then be made into mortar with one of these cements—using one part of lime in paste, to two parts of cement. They must be well mixed together, adding the water, necessary to produce a pasty state. The mortar should then be placed in the bottom of a tumbler. If the mortar be stiff, the tumbler may at once be filled with water; if, on the other hand, the mortar has been made rather thin (which facilitates the mixing) it should he left long enough in the air to assume some consistence before the glass be filled. The same course should be followed with the two other cements, and all the glasses must be ticketed. It is necessary to add, in making the several mortars, such quantities of water as will bring all to the same consistence, nearly. After two or three days, the mortars should be touched lightly with the fingers, to ascertain whether they have begun to harden; and when this happens, they must be examined every day, noting that which hardens first, and the time at which each arrived at that degree of induration that on pressing it strongly with the thumb no impression was made. In order to judge more accurately of this state, the turbid water must be thrown off, and the surface of the mortar, which is always covered with a little semi-fluid matter, must be lightly cleaned with a rag. If the mortar is not yet hard enough to resist the thumb when strongly pressed, it must be again covered with water for subsequent examination. Should there be several brick yards at hand, using different clays, the same process should be applied to the brick dust from each. It will be useless to try dust from tiles, provided the clay is the same as that used for bricks, because the result would be substantially the same.

We have seen that the dust of bricks which have been burned in a current of air, hardened in the space of three or four days, while the dust of bricks burned out of a current of air, has generally taken from ten to twenty days, and sometimes even thirty days to harden, and has, nevertheless, made good mortars. I have also made the remark, that mortars of the hydraulic limes which harden very quickly, did not give great resistances; but those made of cements which have caused fat lime to harden promptly, have always given good mortars. We ought, therefore, to prefer those cements which cause fat lime to harden promptly. If any cement, after fifteen or

twenty days, gives to fat lime only a weak consistence, it should not be employed.

In experimenting with the ashes and cinders of forges, the same process should be followed. If, of these substances, after a month's immersion, any should impart to fat lime but a feeble consistence, or remain entirely soft—in neither case should it be employed.

By means of a very simple chemical process, it may be ascertained before hand, whether bricks but little, or highly, burned, should be taken. Take a little of the crude clay, or a little of the brick dust, put it in a glass and pour over it a little diluted nitric or muriatic acid, or even strong vinegar; should there be no effervescence, it is proof that the bricks should be highly calcined to give good cement. Should there be considerable effervescence, it is because the clay contains a notable quantity of carbonate of lime. To determine nearly the quantity of lime, a little of the clay, having been dried in a gentle heat, must be weighed; it must then be diffused through a small quantity of water, and muriatic acid be poured on, little by little, as long as there is any effervescence; it should then be filtered, or gently decanted, the residue washed in a large quantity of water and again decanted. The residue being then dried in the same gentle heat as at first, must be again weighed; if the weight be less by one tenth, than at first, it is a proof that the clay contained that quantity, about, of carbonate of lime, which has been dissolved out by the acid. In this case bricks but lightly burned must be taken; and so much the less burned as the loss of the clay, by the acid, shall have been the greater. If the clay lose only four or five per cent. of its weight, the bricks which are called "well burned bricks," should be preferred. In addition to the chemical trial just described, it will always be proper to make the trial first explained—that being the most certain.

With brick dust, we may easily obtain mortars which, according to my mode of determining tenacity, will support from 220 lbs. to 330 lbs. before breaking, if composed of equal parts of lime, sand and brick dust. This force is sufficient for gross masonry: but, for important works, such as the floors of locks, foundations of dikes and dams, caps of arches, and for factitious stones, of which I shall speak in the sequel, it is necessary to have cements that will give mortars capable of supporting from 330 lbs. to 440 lbs.

To obtain cements or puzzalonas of the strength just mentioned, we proceed in the following manner. We choose clays soft to the touch, taking, in preference, those of which earthen ware, stone ware, delft ware and tobacco pipes are made, ascertaining, by the above chemical trials, whether there be any lime, and if so, the quantity. Of these clays we make balls of the size of an egg, which we calcine in a reverberatory furnace, heating gently at first, and, after about one hour, pushing the fire so as to keep the balls constantly at a low red heat; the balls, of which there will be ten or twelve, being placed within a large Hessian crucible having a hole in its bottom. To avoid exposing these clays to be struck by a current of cold air, as they would be if put on the bottom of the crucible, a piece of slate perforated with many small holes should be put across the middle of the crucible, (which is commonly of a conical form, narrowest at the bottom:) by this means the balls of clay will be in the centre of heat, and will be, during the calcination, always in contact with a current of atmospheric air. When the balls have been burned for three or four hours, according to the quantity of lime contained in them, one of these balls will be taken out, and

marked with the number of hours it has been under calcination; at the end of every succeeding hour another ball will be withdrawn and marked in like manner. All the balls being withdrawn, they will be reduced to fine powder, and a mortar will be made of each, exactly in the same way as was pointed out for mortars made of brick dust. We shall ascertain, in this way, the time of burning required by the clay, to give to fat lime the most prompt induration, and we shall have an idea of the difficulty to be overcome in reducing the cement to powder. To operate on a large scale proceed as follows.

In countries where wood only is to be burned, a furnace may be made like that in the plate I, Fig. 2. If the clay to be used be greasy, the expense of tempering it may be saved. It will be cut from the bank into pieces, of the form and dimensions of common bricks. These will be dried in the air like bricks, and then be placed on their edges on the hearth of the furnace, laying them obliquely with respect to its axis, and at a little distance asunder; the second layer will be placed on the first, crossing them. A fire will then be made in the two arches below the hearth, gentle at first, and gradually increased. It is apparent that the clay will, in this way, be calcined in a current of air, through the holes in the hearth. These bricks will be heated less intensely than the balls that were in the reverberatory furnace, and it will therefore be requisite to leave them exposed to the fire for a longer period. After twelve or eighteen hours calcination, one brick will be withdrawn. If the clay is coloured with iron, the colour will now be compared with the colour of that specimen of the first trial which gave the most prompt induration to fat lime. If the colours are exactly alike, it is a proof that the clays in the furnace have received sufficient calcination, and the fire will be stopped; but if the colours are different, the heat will be continued, and another comparison will be made, after another lapse of time; and so on until a colour is obtained which indicates the proper degree of burning.

If the clay contain little or no iron, or if the furnace trial showed that the colour varied but little with considerable variations in the intensity of heat, then, having withdrawn, successively, several bricks, reduce them to fine powder, and make several mortars by mixing this powder with fat lime —noting the time required to harden, and taking all the precautions directed for the proof essay. In the first batches burned on a large scale, considerable pains will undoubtedly be required to determine the time requisite for the best degree of calcination; but when this point is once ascertained, there will be no longer any difficulty, and the operation may be confided to ordinary workmen.

In countries where the fuel must be coal or peat, it will be preferable to use a conical kiln for burning the clay. I will observe here, that Mr. Chaptal in calcining the clays of the south, in a conical kiln, placed them, by accident it appears, in the most advantageous position; that is to say, they were so placed as to cause them to be calcined in a current of atmospheric air. If this celebrated chemist had noticed the great action that lime exercises on the calcination of clays; and that it is necessary to heat but little when the clay contains as much as one tenth, and to heat much when it contains little or no lime; he would have completely resolved the important question of the perfection of artificial puzzalonas. In many of the northern Departments, conical furnaces are used for burning lime. Plate I, Fig. 3, represents one of those furnaces which I saw in the neighborhood of Paris. The following is the mode to be adapted in burning clays therein. Instead of

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In countries where there is neither coal nor turf, it seems to me that the conical furnace might still be used for calcining clays. It will suffice to take dry wood, and in preference round sticks, which should be cut into lengths of four inches: these little pieces should be mixed with the clay balls, and the operation of burning should be like that with coal. I do not doubt that a good result would be obtained.

Clays which are greasy to the touch are easily formed into balls, or shaped like bricks, without any preparation; but it is possible, it may be necessary to temper such clay as is used in brick making, this being generally more meagre.

When very greasy clays, containing no lime, are used, it will sometimes be difficult to reduce the cement to powder without machinery. In such cases, clays should be preferred which are not too greasy and which contain about five per cent. of lime: these clays are, moreover, more common than others. It is not to give energy to the cements that we should prefer earths containing a little lime: we have seen that opposite effects are sometimes produced. But the presence of this substance has two considerable advantages; the first is that the clay requires less burning to yield good puzzalona, whence results an economy as to the fuel: the second is that the clay containing lime is more easily reduced to powder. Thus it might be well to mix a little lime with clays which contain none, or to mix clays which contain no lime with clays that contain too much: but as these operations require a good deal of work, it will be necessary to calculate the relative expense of the several modes, namely, burning the clays hard, and pulverizing them, though with difficulty—mixing a little lime with the clay—or mixing clays together. The relative expense will depend on the price of fuel, and the means at command for breaking down the clay. A pestle mill, or mill with large stones, like those used in pulverizing plaster of Paris, would, it appears to me, be most convenient.

The name *puzzalona* expresses that this substance is obtained from the village of Pouzzol in Italy—that of *trass*, has no etymology. In the notice which I published in 1825, I proposed to give the name hydraulic cements to substances substituted for trass and puzzalona. This denomination appears to me to be convenient, and I shall generally employ it. I have entered into many details as to the fabrication of these productions because they are of great importance in constructions. I proceed to report sundry experiments that I made with hydraulic mortars.

[TO BE CONTINUED.]

Physical Science.

Speculations respecting Electro Magnetic Propelling Machinery.

By the Editor.

In our number for November last, Vol. XX, p. 340, we published the specification of Mr. Davenport's patent for a machine intended to furnish a motive power by the agency of Electro Magnetism, to which we appended some remarks upon the subject generally. We had hoped, ere now, to have received more definitive information than has transpired, respecting the progress of the experiments which are being made in New York with a view to its testing the utility by applying it to drive a Napier Press, requiring a two horse power; we have hitherto learnt nothing of the result,

of this proposed experiment; and suppose, therefore, that the trial has not yet been made.

Since publishing the article above alluded to, it has appeared to us that should a much less power be attained by such a machine than that which is now sought for, say the power of a man only, it would still be equally valuable with the steam engine, and would produce as great, if not a greater change, in the economy of the useful arts, as has been produced by that instrument; this, however, is under the proviso that the cost of materials consumed in performing the work of a day should be less than that given for the labour of a man. Who is there who would not under such circumstances, need such a machine? If we hire a man by the day we must not allow him to be idle, as in that case we give our money for nothing. The current of his life flows on, and he must be fed and clothed or the stream will stop. But give us a machine which is not costly at first, and which if it works but one hour in the twenty-four, will itself be a consumer in that proportion only; a machine which we can at any moment set to turn our lathes, our grindstones, our washing machines, our churns, our circular saws, and a catalogue of other things which it would be no easy task to make out; such a machine would also perform a million of other operations by the conversion of the rotary into a reciprocating motion; and we again ask who is there among us who would not want one? our farmers, our mechanics, and our housekeepers generally, must all be supplied. We could no more submit to live without it, after it has been once introduced, than we can now submit to travel at the slow rate of ten miles an hour, an event which we have learnt to think one of the miseries of human life.

With such a machine at our command we should soon wonder how we could have lived so long without it; and if taken from us it would leave a most awful chasm in the necessaries of life, of the existence of which our fathers never dreamed, and which happily we could not be called upon to witness so long as the store house of nature would enable us to obtain zinc and sulphuric acid at a cheap rate.

The steam engine cannot be used to advantage where it has not the labour of several horses to perform, as, whether large or small, it requires the constant attention of the engineer, or of the fireman, and is kept at work at an expense which is relatively increased as its power is diminished. One giving the power of a man only would be employed, at a cost which would pay the hire of two or three men, and if used but for an hour or two in the day, the expense would be incalculably increased; of course it is not, and never will be used, under such circumstances.

Let it not be said that we are prophesying about what is to happen; not so by any means; but be it remembered that we are speaking of what is a possible contingency. We have no doubt respecting the practicability of obtaining the power of a man by the agency of electro magnetism; we believe that such a machine may be kept at work without any considerable tax upon the time of the person using it, and we further believe that the only thing which can prevent its coming into use is, the cost of the materials employed in operating it; the statements which we have heard upon this point are extremely contradictory, and upon the whole, are far from encouraging; the time, however, is not remote when this point will be determined.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Reduction of observations of the Solar Eclipse of July 26th and 27th, 1832.

By E. Otis Kendall.

This Eclipse was observed at several places in Europe and America, as follows:

No.	Place of observation.	Latitude.	Phase obs'vd.	Mean time of observation.	Observer.
				d h m s	
1	St. Croix.	+17° 44′ 32″	Begin.	26 19 11 52.80	Andrew Lang.
2			End.	21 34 16.30	
3	Phila. 0.12s. E. of	+39 56 59	Begin.	18 54 46.20	S. C. Walker.
4	State House.		End.	20 39 20.20	
5	Phila. 0.7s. W. of		Begin.	18 54 54.60	Wm. Mason.
6	State House.		End.	20 39 13.40	
7	Warminster Pa.	+40 8	End.	20 39 8.30	E. W. Bean.
8	Albany,	+42 39 3	Begin.	19 7 2.50	Prof. Alexander.
9			End.	20 45 45.50	Cerquero.
10	San Fernando,	+36 27 43.5	Begin.	27 1 3 31.50	Sanchez.
11			End.	3 9 4.75	Montojo.
12	Marseilles,	+43 17 50.1	Begin.	2 23 37.43	Gambart.
13			End.	3 35 35.21	
14	Padua,	+45 24 2	Begin.	3 11 33.70	Santini.
15			End.	3 47 10.80	
16	St. Helena,	—15 55 26	Begin.	2 33 44.00	Johnson.
17			End.	3 32 24.30	Armstrong.

It therefore furnishes a good opportunity for determining the longitudes of several places in this country by comparison with corresponding European Observations.

The Sun's and Moon's places in the Berlin Jahrbuch for that date, were used in computing the following Elements and Co-ordinates with the logarithms of their variation in a mean solar hour, according to the method of Bessel, (Ast. Nacht. No. 321.)

		log. Hourly Variation.		log. Hourly Variation.
T	1h 20m		2h 20m	
σ	9h 40m 43.64s		10h 40m 53.50s	
x	—0.893492		—0.315999	
y	+0.221782		+0.139504	
a	+126° 43′ 23″.23	+2.1534	+126° 45′ 45″.60	+2.1534
$l.$ cos. d	+9.975198	+5.3901	+9.975222	+5.3892
$l.$ sin. d	+9.516584	—6.3063	+9.516382	—6.3070
l	+0.530935	+5.8290	+0.530989	+5.6232
N	+ 98° 5′ 44″.77	+1.6658	+ 98° 7′ 23″.09	+1.7203
$l. \frac{s}{n}$	+3.790347	+5.6580	+3.790430	+5.5472
$l.\ h$	+0.225087		+0.225209	

		log. Hourly Variation.
T	3h 20m	
σ	11h 41m 3.35s	
x	+0.261358	
y	+0.056945	
a	+126° 48′ 7.95″	+2.1533
$l.$ cos. d	+9.975247	+5.3892
$l.$ sin. d	+9.516179	+6.3075
l	+0.531019	+5.1833
N	+ 98° 9′ 4.09″	+1.6810
$l.\frac{s}{n}$	+3.790502	+5.5916
$l.$ h	+0.225324	

Using these Co-ordinates and Elements I have deduced, by Bessel's formulæ, in the paper above referred to, the following co-efficients of ε ζ and η,

No.	m	a	b	c	d
	h m s				h m s
1	—4 18 28.188	+1.679	—0.086	+1.681	—4 18 50.915
2	—4 18 27.047	+1.680	+0.453	—1.740	—4 18 38.740
3	—5 0 12.377	+1.679	+1.446	+2.215	—5 0 40.278
4	—5 0 27.144	+1.680	—0.970	—1.940	—5 0 35.085
5	—5 0 4.003	+1.679	+1.444	+2.215	—5 0 31.902
6	—5 0 32.185	+1.680	—0.971	—1.940	—5 0 40.125
7	—5 0 32.963	+1.680	—0.985	—1.947	—5 0 40.852
8	—4 54 21.852	+1.679	+1.675	+2.371	—4 54 50.797
9	—4 54 44.768	+1.680	—1.180	—2.053	—4 54 51.859
10	—0 24 27.767	+1.680	+0.832	+1.875	—0 24 53.144
11	—0 24 37.785	+1.680	—1.557	—2.291	—0 24 43.224
12	+0 22 3.752	+1.680	+2.044	+2.646	+0 21 33,040
13	+0 21 15.630	+1.680	—3.754	—4.113	+0 21 21.371
14	+0 48 19.213	+1.680	+3.848	+4.201	+0 47 39.111
15	+0 46 40.356	+1.680	-10.024	-10.164	+0 47 21.045
16	—0 21 44.566	+1.680	—7.827	+8·005	—0 22 13.294
17	—0 22 27.846	+1.681	—2.440	—2.962	—0 22 39.423

Where

m = the Longitude + East, — West from Greenwich which would result from these observations, if the places of the Sun and Moon as given in the Berlin Jahrbuch were free from error.

Making

ε = the correction of the tabular place of the Moon in its orbit, in seconds of space.

ζ = the number of seconds of space by which the Moon is farther north or south than its tabular place.

η = the correction of the sum of the tabular semi-diameters of the Sun and Moon in seconds of space.

d = the longitude from Greenwich resulting from the application of these corrections as far as determined, then by Bessel's formulæ,

$$(A) \ldots\ldots d = m + a\varepsilon + b\zeta + c\eta$$

From the above equations the most probable values of ζ and η have been determined by Gauss', method of least squares and are as follows, $\zeta = -2''.1350, \eta = -3''.5622$. With these values of ζ and η, and their co-efficients b and c above, the values of ε have been obtained by adopting for the longitudes of San-Fernando, Marseilles and Padua, those contained in the Nautical Almanac for 1838.

No.	Place.	Phase.	ε	Mean of Beginning and End.
10	San Fernando.	Beginning.	— 7″.668	—10″.617
11		End.	—13 .567	
12	Marseilles.	Beginning.	—12 .478	— 9 .005
13		End.	— 5 .532	
14	Padua.	Beginning.	—15 .973	—10 .596
15		End.	— 5 .219	
Mean of all the values of ε = — 10″.073.				

$$\text{Thus we have } \varepsilon = -10''.073$$
$$\zeta = -2.135$$
$$\eta = -3.562$$

These values in the equations (A) furnish for d the results found in the third table, which are the most probable longitudes of the places of observation as derived from this eclipse. The longitudes deduced from the American observations are here repeated.

		h.	m.	s.
St. Croix, A. Lang's Observatory W. of Greenwich,		4	18	44.83
Phila. State House, by S. C. Walker's Observation	W. of "	5	0	37.80
" " Wm. Mason's "	" "	5	0	35.31
Warminster, Bucks county, Pa. by E. W. Bean's	" "	5	0	40.85
Albany Academy, by Prof. Alexander's "	" "	4	54	51.83

In making the above computations, the ellipticity of the earth was assumed to be 0.00324.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Simultaneous Meteorological Observations. By John W. Draper, M. D. *Prof. of Chem. in Hampden Sydney College, Virginia.*

The importance of the subject of meteorology, is at last beginning to be understood and felt by the scientific world; and in many parts of the United States private individuals have commenced keeping journals for the express purpose of aiding for the development of the laws, regulating the atmospherical phenomena. These journals, however, insulatidly considered, are of but little service; it is only when they stand in comparison with other similar papers containing observations made simultaneously at distant points, that their true value becomes apparent.

The faculty of Hampden Sydney College, Virginia, considering how desirable it was to organize a corps of efficient observers throughout the State, in case any thing should be done by Congress to provide the means for making this kind of observations, resolved, that in addition to the usual college duties of the senior class, they would hereafter require of them to keep a meteorological journal, containing at least three observations each day, Sunday excepted, of the barometer, thermometer, wind, and general observations, and the dew point once at least. On the plan going into

operation, a number of individuals of the junior class volunteered their services; classes were arranged for each kind of observations and the general supervision given to the professor of Natural Philosophy.

It is highly desirable that similar arrangements should be made in every College in the United States. At Hampden Sydney the plan has been found to work without difficulty, and the hours of observation, having been judiciously arranged with reference to other College duties, the young men have little or no extra trouble. Colleges are the natural depositories of this kind of information—and as most of them, perhaps all, possess the requisite instruments, these operations can be conducted with extraordinary facilities;—Nor does the advantage end there, for an extensive class of able observers is gradually disseminated through the state.

I send herewith the result of the observations of the senior and junior classes, for the last month, to be disposed of as may appear best, and if published I hope it may draw the attention of other Colleges, in other States, to the subject. In this State, I have reason to believe it will be the cause of a systematic series of operations.

Meteorological Observations for Nov. 1837, *Hampden Sydney College, Va.*

	Therm.			Min.	Barom.			Annex'd Therm.	Dew point.	Wind.	General remarks.
7	56	65	61		29.64	29.49	29.58	64.84	40	SW. NW. N.	
8	36	52	54	34	29.90	29.95	29.95	56.62.62	46½	NW. NW. E.	
9	42	60	60	30	29.93	29.92	29.80	53.60.60	37	SW. W. W.	
10	56	62	60	52½	29.79	29.78	29.68	59.60.62	58	SW. SW. NE.	Rain till 12 o'clock.
11	50	56	56	41	29.66	29.63	29.53	58.61.62	57		Fog. all dny.
12											
13	50	52	48	41	29.37	29.40	29.37	63.63.61	51	NE, NE. NE.	Rained from 8. A. M. all day.
14	40		48	38	29-32	29.35	29.41	55 56.56	39	NW. NW. N.	Cloudy till 12.
15	35	56	48	25	29.61	29.64	29.65	51.53.54	42½	NW. SW. SW.	Aurora seen this evening.
16	30	50	50	24	29.75	29.83	29.84	47,53.53	37	W. N. NE.	
17	34	48	50	25	29.96	29.99	99.97	47.57.57	41½	SW. W. SW.	
18	38			32	29.88	29.84	29.77	50.56.58	43½	SW. SW. SW.	
19											
20	52	66	68	41	29.76	27.78	29.74	62.69	55	SW. SW. SW.	
21	48	66	67		29.66	29.63	29.55	70.67	55	SW. SW. SW.	
22	55	67	68	51	29.20	29.00	28-78	69.70.71	58	SW. SW. SW.	Storm from SW. P. M. commencing 4½. till 9 P. M.
23	30	35	36	28	28.97	29.03	29.04	55.51.54	19	NW. W. W.	
24	29	38	35	25	28.99	29.04	29.03	39.51.46	18	W. NW. W.	Cloudy.
25	23	32	23	19½	29.39	29.23	29.23	35.45.42	32½	SW. SW. W.	
26											
27	26	43	46	7	29.73	29.87	29.87	33,49.49	31	SE. SE. S.	
28	37	51	53	30	29.95	29.99	29.95	43.47.49	41	NW. W. W.	
29	43	60	63½	31	29.95	29.93	29.87	49.56.58	42	SW. SW. W.	
30	50	63	64	42	29.83	29.87	29.79	56.61.63	49	SW. SW. SW.	

We are gratified in receiving from our esteemed correspondent, the foregoing remarks and meteorological observations, so much in unison with the wishes heretofore expressed in this Journal. It is, however, more especially desirable that *simultaneous* observations, *on the plan*, and *at the periods*, recommended at page 190 of our last volume, should be made throughout our country.

COM. PUB.

Franklin Institute.

Conversation Meeting.

The fourth monthly conversation meeting of the season was held at the Hall of the Institute on Thursday evening, 28th of December.

Mr. James Swaim exhibited, for the second time, his powerful magneto-electric machine, and, as on the former occasion, it excited much astonishment in all who had the temerity to try its effects, and produced no little amusement at the expense of the experimenters.

Mr. Andrew Stevens put in operation a model of Mr. Davenport's galvano magnetic machine, similar to those at the Masonic Hall.

Dr. Robert Rogers presented to the Institute one of his revolving galvanic batteries, designed to maintain constant activity.

A very neat specimen of statuary, from the chisel of Mr. Drache, was presented to the Institute by that artist.

Mr. W. F. Ketchum exhibited his method of increasing the adhesion of locomotives on inclined planes, by means of small driving wheels fixed on the axles, outside of the large wheels, and adapted to an angular, or wedge shaped rail, laid on the steep grades, and raised above the ordinary rail.

Numerous samples of American manufactured hardware and cutlery were exhibited by Messrs. W. H. Carr & Co., Messrs. Curtis & Hand, and Messrs. English and Huber, also some beautiful specimens of American cut glass, by Mr. Wm. Muzzy.

The Hall was visited in the course of the evening by Governor Ritner, and a number of other distinguished strangers, who expressed much gratification at witnessing the interesting display of scientific and mechanical novelties.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN APRIL, 1837.

With Exemplifications and Remarks by the Editor.

52. For improvements in the *Manufacture of White Lead;* Peregrine Phillips, Campbell county, Kentucky, April 17.

The lead is to be rolled into sheets, or shotted, but it is preferred to be feathered, that is, granulated, by pouring it, in a small stream, into water. The prepared lead is then to be placed in a vat with a perforated false bottom at about its middle, where the lead is to be sustained. A pump is to be placed so as to pass through the false bottom, or in such manner as to allow the liquid contained in the vat to be pumped up. A steam pipe, of pure tin, &c., is to pass once, or more times, round within the vessel; and a tube through which air may be blown, is also to pass into the vat, below the false bottom. Distilled vinegar, or dilute acetic acid, containing about two or three per cent of dry acetic acid, is then to be poured into the vessel, to such height as not to interfere with the passage of air through the feathered lead. The pump is then to be worked, and the liquid to be so distributed by it as that the lead shall be kept constantly moistened. The acid may be kept at a temperature of 85 or 90 degrees by the passing of steam through the steam pipe. A blowing apparatus is to be kept at work at the same time, throwing in atmospheric air, to oxidize the lead as it passes up among it, which oxide will be dissolved by the acid, forming an acetate. When saturation is perfect, the fluid is to be drawn off into a

cooler, and a fresh portion supplied to the lead, and this repeated until the whole is dissolved. The saturation may be judged of by the specific gravity ceasing to increase.

The saturated liquid is to be put into a vat, called a carbonating vat, constructed like that for saturating, but, instead of lead, having twigs, or pebbles, &c., upon the false bottom. Upon this brushwood, &c., the saturated liquid is to be pumped, whilst a quantity of carbonic acid, or a mixture of it with other air, is to be forced into the vat below the false bottom, which as it passes up, will convert the acetate into a carbonate, and this, being insoluble, will fall to the bottom in the form of an impalpable powder. When the precipitation ceases, the liquid is to be drawn off, and used again in the first vat, and so on continuously. The precipitated lead is to be thoroughly washed, then dried, and the process is completed.

The whole apparatus used is clearly described, and full estimates are given of the respective ingredients necessary to produce the desired reaction. The following are the claims.

"I claim as my own invention, *first*, the oxidation of the lead, and dissolving of the said oxide by means of pumping or throwing diluted acetic acid, or vinegar over lead when in a state exposing a large proportion of surface, at the same time drawing, or forcing, a current of atmospheric air through the interstices of the said lead; and I claim this only for the purpose of preparing a liquor to be used in the manufacture of white lead.

"I claim *secondly*, the pumping or throwing the aforesaid solution of lead over any substance or materials placed in an atmosphere composed wholly, or in part, of carbonic acid gas, or for pumping or throwing the aforesaid solution into the atmosphere as before said, so that it shall fall down through the said atmosphere, for the purpose of manufacturing white lead.

"I claim *thirdly*, the purifying of the vapour of burning charcoal by causing the same to pass through a stratum of pebbles, or other substances, which substance shall be kept moist by the constant or occasional injection of water over them. And I claim this only for the purpose of assisting in the manufacture of white lead."

This latter claim refers to the removal of all dust, or other impurity, which might enter with the gas, and injure the colour of the lead.

We doubt the economy of the process of forming the acetate in the first instance, and are not aware of its superiority in any respect, to the usual mode of manufacturing that salt from litharge. The carbonating is substantially the same with the French process described in Gray's Operative Chemist, and in other works; the particular management described by the patentee is all that he can hold, as being the only novelty presented to us.

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53. For improvements in *Smoke Stacks, Flues, &c.*; James Stimpson, City of Baltimore, April 17.

The object in view is said to be so to construct the chimneys, or flues of steam engines, smith's forges, &c., as to generate heat, and prevent the escape of sparks, ashes, cinders, or soot. The instrument is denominated the "draught accellerator, and centrifugal spark catcher." The contrivance itself is somewhat complex, and the description of it much more so. Much space is occupied also by directions to the workmen how to cut and join the separate parts, which is altogether foreign to the matter in hand. A part of the flue is to ascend in a spiral form, and in speaking of this, we have some philosophical information which seems to furnish one of the pro-

perties of a patentable article, novelty. Not to mar the affair, we will quote the passage.

"I should recommend the spiral to be so formed as to have the ascent go round with the sun, like a back handed screw;—as nature inclines fluids, air, &c., to move, when in a spiral or circular manner, with the sun. And as it is as easy to make it ascend one way as the other, it would be best to let nature have her own way."

The smoke from a steam engine furnace, &c., is to ascend up a pipe to some distance in the usual way; there is then an opening made in the side of the pipe, through which the draught is to pass into a flue ascending spirally around the pipe as its shaft, or centre; an outer case covers the outer edges of the spiral thread, so as to make an enclosed flue. This it is said, will give to the sparks, dust, &c., a centrifugal force, inclining them to fly off tangentially; and to enable them to do so, there are slats, or openings in various parts of the outer case of the spiral, which openings are covered by troughs, called receivers, leading downwards, in which the sparks, ashes, &c., are to be precipitated to the bottom, where they are received and retained until removed.

The claim is "the combination of the spiral flue, with the outlets and receivers, constructed as above set forth, or in any other manner whereby a centrifugal force is, or shall be, obtained," &c.

We wish that this contrivance may have the effect of removing a great nuisance in rail road travelling, but we do not anticipate it, being apprehensive that but a small portion of the sparks and ashes will leave the ascending current and find their way into the receivers.

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54. For an improvement in the *Tongues of Power Loom Shuttles;* Comfort B. Thorp, Smithfield, Providence county, Rhode Island, April 17. (See specification.)

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55. For a *Revolving Hand Rake for hay or grain;* Stephen Coats, Shoreham, Addison county, Vermont, April 17.

This revolving hand rake consists of a rake head which is about six feet long, with teeth about two feet ten inches long, running through said head, and projecting out on opposite sides. To this head is affixed a pair of shafts, within which the person drawing the rake is to walk, a strap passing in front of him to aid him in drawing. The rake head revolves on the hind ends of the shafts, in loops formed by iron straps, there being catches to stop the head in a proper position for raking, and a lever at the command of the operator, by which the rake can be disengaged when fully loaded, and thus allowing it to revolve so as to bring the opposite row of teeth into action. The claims are to the particular mode of constructing the operating parts as described in the specification.

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56. For a machine for *cramping leather for the legs of boots;* Jesse Van Winkle, Rochester, Monroe county, New York, April 17.

This machine, in its general construction, is like several others, differing only in certain special points of structure, which we shall not attempt to explain. The claim is made to the "slides or sliding planes, with the projecting bars, or narrow plates, for removing the wrinkles from the leather."

57. For improvements in the mode of *Propelling Boats on canals and rivers;* John Finlay, City of Baltimore, April 17.

A rail, or string piece, is to be placed along the side of the canal, or other water, or it may be so supported by posts as to stand above the boat. This rail is to be embraced between two friction wheels, bearing on opposite sides of it, one of which wheels is to be made to revolve by steam, or other power, on board the boat; the frame which carries the wheels being so constructed that it may vibrate, and adapt itself to the level of the water. It is proposed sometimes to place rails upon a tow path, with a carriage adapted thereto, to be drawn by horses, instead of allowing them to draw directly by a tow line attached to the boat.

"Now what I claim as my own invention, and wish to secure by letters patent, consists in the application of a string piece, or rail, secured to posts placed near the edge of the water in canals, or over the tops of boats used on canals or rivers, and applying to the sides of said string piece, or rail, a wheel or wheels attached by a frame to a boat, with joints so as to adapt the whole to the depth of the water, operating nearly in a horizontal line; and to which wheel or wheels I apply the propelling power, causing the boat to move with velocity and without injury to the banks of the canal. I also claim the use and application of the guide frame with the friction rollers, to keep the boat parallel with the canal. I also claim the use and application of a frame with wheels to operate on the road above described, for horses to move with on the tow path to propel boats on canals; said frame having two wheels whose planes are oblique to the horizon, secured by friction rollers acting on opposite sides of the rail, being easily removed so as to disengage the wheels from the rails when boats are required to pass each other, or for any other purpose. I also claim the use of my invention on the ice during winter, the boats being placed on runners."

A plan for propelling upon canals, in some points resembling the foregoing, was patented by Prof. Chas. Bonnycastle, of the University of Virginia, on the 21st January, 1834, and is described in our 14th volume, p. 118.

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58. For an improvement in the *Standing Press;* Joel Barns, City of Philadelphia, April 17. (See specification.)

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59. For an improvement in the manner of *Constructing Rail Roads;* Uri Emmons, Freehold, Monmouth county, New Jersey, April 17. (See specification, Vol. XIX, p. 480.)

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60. For improvements in *Fire Arms;* Elijah Fisher, Springfield, and Dexter N. Chamberlain, Boston, Massachusetts, April 17.

Behind the barrel of the gun, or rifle, a longitudinal slat, or mortice is made, into which the back end of the barrel opens. This rectangular opening is to receive a block, or piece of metal, which is so fitted as to slide easily through it. Into this piece of metal, several chambers are bored parallel to each other, and capable of being brought in succession to coincide with the bore of the barrel, a nipple being fixed over the rear of each chamber to receive a percussion cap. There are also the contrivances necessary for arresting the sliding block, and holding it in place, and also for forcing it into close contact with the barrel at the time of discharge.

"We claim as our invention and improvement, *first*, a piece or block of metal, having any number of chambers therein to contain separate charges

of powder, balls, and shot, to slide in a rectilinear direction through a slat or passage formed in such a manner between the barrel and breech, as to admit of the axis of each of the chambers to be brought in succession in a right line with, or to correspond to, the axis of the barrel. *Second.* The mode of confining the piece or block of metal in different positions by means of a pin, projecting from a sliding piece of metal, and notches formed in the edge of the face of the piece, or block of metal. *Third.* Forming the key wedge shaped, for the purpose of pressing the block close against the side of the slat, or end of the barrel, to prevent windage."

61. For improvement in the *Loom for Weaving Coach Lace, &c.;* Erastus B. Bigelow, West Boyleston, Worcester county, Massachusetts, April 17.

This coach lace power loom is very fully described, and well represented in the drawings. The novelties, also, are distinctly claimed; but we shall not attempt an epitome, as without the drawings it must be obscure; the insertion of the claims would also be useless, if given alone.

62. For a Furnace for *Smelting Iron Ore by the use of Anthracite Coal;* George E. Sellers, Upper Darby township, Delaware county, Pennsylvania, April 20.

In this furnace the fuel is to be contained in a stack distant from that in which the smelting is to be effected. The latter is to contain the ore, with the necessary flux, and such portion of coal as may be required to carbonate the iron. The tuyere is in front of the fuel stack, and on the opposite side of this is an opening, called a concentrating flue, leading into the smelting stack, and in this passage there is a depression forming a timp, or receiving chamber, into which the metal runs as it is smelted, the bottom being inclined for that purpose. The necessary devices for performing the different operations appropriate to a furnace are, of course, appended to this. It is not pretended that the placing the fuel in one stack, and the mine in the other, is, by itself, new; but the novelty claimed consists in the particular construction of the furnace in its combined character. The patentee says, "I do not intend to claim the parts described in their individual characters. There is nothing new, for example, in the mode of feeding adopted by me, or in the principle of passing the blast through a stack containing fuel only, and causing the blast and heated air, therefrom, to enter a second chamber containing the ore to be smelted, this having been previously performed, or essayed. But what I do claim is that particular arrangement of the respective parts of the within described furnace by which it may be distinguished from all those which have preceded it; intending by this particular arrangement, the manner of connecting the main furnace for fuel with that containing the ore to be reduced, by a concentrating flue, within which is contained a receiving bed for the reduced metal, constructed and operating in the manner herein set forth, combining the same with the smaller flue above it, for the purpose herein fully shown. I also claim the provision for removing the slag from the fuel under the main furnace, by means of one or two openings constructed for that purpose, upon the principle, or in the manner, described."

"The smaller flue," above referred to, is one situated above the concentrating flue, and like it leading from the fuel stack into the smelting stack; its design being to conduct a portion of the heat into the smelting stack at

such height above the bottom as may be useful in preparing the materials for the full action of the blast.

63. For a machine for washing *Iron and other ores;* Frederick Fredly, Logan township, Centre county, Pennsylvania, April 20.

The ore is to be put into a long polygonal receiver, which turns on gudgeons like a dash wheel, and this is made to revolve with its lower side dipping into a trough or cistern containing water. The axis of the receiver is inclined, the ore is put in at the upper end, and a portion of water is also scooped in at every revolution. There is an opening at the lower end for the materials to pass out. The things claimed are certain peculiar points not possessing more novelty than was absolutely necessary to justify the granting of a patent. They consist in "the inclined strips at the ends of the polygonal case for directing the ore from the upper to the lower end of it, and into the inclined spouts. The inclined spouts at the lower end of the case, and the scoops at the upper end."

64. For an improved mode of *Applying the Blast to Furnaces;* John Barker, City of Baltimore, April 20. (See specification.)

65. For a new *Body for Hats;* Hugh Moore, City of New York, April 28.

The following is the whole substance of the specification. "The body is formed of cloth, the warp of which is strong cotton yarn, and the weft of alternate layers of strong cotton yarn and whalebone; or otherwise made of split whalebone attached to any kind of cloth by an adhesive water proof composition. The bodies, of both kinds, are joined at the sides by needle work. The brims and crowns are made of the same material, and I have also made them with brims of Canton flannel, and felt, and the crowns of layers of muslin of different degrees of strength.

"What I claim as my invention, and desire to secure by letters patent, is the application of whalebone to hat bodies, by which they will be rendered more elastic and durable than those made of felt, calico, or any other substance."

67. For a *Furnace for the Manufacture of Shear Steel, and of Cast Steel,* by the use of anthracite coal; Simeon Broadmeadow, City of New York, April 5.

The furnace described is said to be one which is calculated to make about one hundred and sixty pounds per day. The ash pit is to be in the usual form, about eighteen inches high, five inches diameter at bottom, and seven at top. The furnace part eighteen inches in diameter, and four feet six inches high from the grate bars: surmounted by a flue forty feet in height, and nine inches square.

There are to be six small interior flues, which are to surround the furnace inside, each having an aperture of about an inch square. These flues extend from the grate bars to a point a little above the top of the crucible, and, of course, built with the furnace, giving to its interior somewhat of a hexagonal form. They serve to admit air at their lower ends, and to deliver it at their upper ends, below the surface of the burning fuel, so as to produce perfect combustion about the upper part of the crucible. These flues may be varied in number.

The principal things relied on are these interior flues, and the great height of the furnace stack, "that is to say, a chimney of extraordinary height for the size of the furnace, and furnished with interior flues, operating in the manner, and for the purpose, set forth."

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68. For a *Furnace for Smelting Iron by means of Anthracite Coal;* Simeon Broadmeadow, City of New York, April 5. (See specification.)

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69. For an improvement in the *Lamp for Lighting Houses,* for which Letters Patent were obtained on the 6th of October 1835; Samuel Rust, City of New York, April 20.

The kind of lamp which is the subject of this patent, has the wick, which is flat, raised and depressed by a roller in the stopple, or burner. Mr. Rust has introduced several improvements into this kind of lamp, and has obtained patents for them at a date subsequent to that now under notice, and which will receive attention in due course. One of the claims made in the present instance, is to "the casting or making of the portion which constitutes the usual stopple, and the vessel of the common close lamp (which holds the oil) all in one piece." There is also a claim made to the "constructing of the roller in such lamps movable, to take out of the tube, or lamp, and put in at pleasure." As the stopple is solid with the lamp, it is necessary to leave an opening in the top for filling the lamp, and this is covered by a flat cap, or valve, which turns on a pin, which device is claimed as combined in a lamp of this description. There are some minor claims to particular things which need not be mentioned here. As respects the lamps themselves, we have them in use, and prefer them very much to the house lamps as commonly made.

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70. For improvements in the *Rotary Steam Engine;* Roger M. Sherman, Fairfield, Connecticut, April 25.

We have had repeated occasions to record our want of confidence in the successful employment of rotary steam engines, and we have not yet arrived at a period when we can announce a change of opinion. The numerous engines of this kind which have been patented here and in Europe, might probably be arranged as constituting five or six different species, each of which has been presented under various modifications in matters of detail, by which modifications it has been hoped that the particular difficulties, and objections found to exist to them might be removed. Our opinion, however, is, that there must be some new species discovered before the rotary will become a competitor with the reciprocating engine, and that, therefore, the one now before us, will share the fate of its predecessors. We cannot, without the drawings, furnish an account of the new devices proposed by the present patentee. Some of them have a near resemblance to such as have been previously used, although differing enough from them to justify the grant of a patent. The following is an abstract of the claims.

The grooves in which the valves, or pistons rise and fall in a revolving chamber, or the so adapting the valves that they shall be rendered close by the pressure of the steam, without packing. The application of pressure by means of a spring upon the stop, causing it to bear upon the sides and bottom of the chamber, and prevent the escape of steam, without packing. The combination of packing rings with lateral springs acting thereon

so as to prevent the escape of steam between the cap and the chamber, without the use of packing; and the pressure of the cap upon the revolving chamber by means of springs, to effect the same object."

71. For a *Cradle for Cutting Hemp;* Wilson A. Larimore, Paris, Bourbon county, Kentucky, April 25.

This is a modification of the common cradle, fitting it to the purpose of cutting hemp by hand. The claim is to "the construction of a bow, or guard, around the points of the fingers, and its extension to the post. Likewise the cord which confines the bow, and extends to the sneath. Likewise the confining of the scythe at the point to the frame, by a screw or otherwise. Likewise the hoop confined on, or near, the back of the scythe."

The object appears to be to render the instrument firm and steady, for cutting the heavy substance to which it is to be applied.

The points of the fingers are inserted into a hoop, connecting them together there as well as at their back ends, and from the frame thus formed a rope extends to the upper end of the sneath, to support said frame.

72. For an instrument for *Measuring and Draughting, preparatory to cutting out Garments;* William C. Bishop, Ovid, Seneca county, New York, April 25.

We have a specification and drawing of this instrument, but do not suppose the subject of sufficient general importance to justify the expense of an engraving, and the space for the description. The instrument consists of flexible graduated metallic straps, to which measuring tapes are attached, and the claim is to "the particular mode in which they are connected and arranged," which so far as we can judge in a matter foreign to our general pursuits, appears to adapt them well to the purpose intended.

73. For an improvement in the *Cotton Gin;* Alexander Jones, City of New Orleans, April 25.

The principal improvement in this cotton gin consists in the manner of feeding the seed to be cleaned. The seed is put into hoppers, the bottoms of which are formed of parallel bars, the spaces between these bars being such that the seed cotton may be drawn through by the teeth of revolving feed plates, constructed for that purpose. To regulate the feed the hoppers are made to raise and lower, giving to the teeth of the feed plates more or less hold. The claim is to "the method of feeding the cotton to the saws by means of hoppers and feeding cylinders, constructed and operating substantially upon the principles set forth."

74. For a *Bodkin for inserting Corset Rings;* Jonathan S. Turner, Middletown, Middlesex county, Connecticut, April 25.

Corset, or other grooved rings, are to be inserted into cloth or canvass by means of an instrument that will make a hole in the cloth of the size of the neck of the ring to be inserted, and at the same time convey the ring into the cloth. A taper bodkin is to be made of ivory, or other suitable material, and this is to be cut across at such distance from the point where it is equal to the diameter of the grooves, the two sections forming a point and handle. From the handle a pin is to project about an inch in length, and of a size fitting the hole in the corset ring. The point is to be bored to receive the pin projecting from the handle, and the instrument is complete.

To use it the corset ring is first put upon the pin, and the point then passed on to it, so that the ring is embraced between the two sections. The point is then forced through the cloth, up to the ring, and with the nail, scissors, or other instrument, the cloth around the hole is forced over the lip into the grooves. The claim is to the instrument as above described.

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75. For an improvement in *Many Chambered Cylinder Fire Arms;* Daniel Leavitt, Cabotville, Hampden county, Massachusetts, April 29.

This is one of those fire arms which have several chambers bored in a cylinder, the axis of which is parallel to the axis of the barrel of the gun, and which chambers can be successively made to coincide with the said barrel. Such revolving cylinders have heretofore been made flat at the end which fits against the barrel, and the present improvement consists in substituting a hemispherical, or convex form for this flat one, the back end of the barrel being so hollowed as shall make it fit accurately on to the cylinder. The object in view is to prevent the danger of accidental explosion in chambers not brought up to the barrel; a thing which is liable to occur in the flat ended cylinders from that portion of the charge which escapes between them and the barrel, but which cannot come into contact with the chambers when the end is convex.

"What I claim as my improvement, is the giving to the chambered or forward end of the cylinder a convex form, by which the ignition of the charge in a chamber contiguous to that which is being fired, is prevented, upon the principle, and in the manner herein set forth."

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76. For *Many Chambered, non recoil, Fire Arms;* John W. Cochran, City of New York, April 28.

In fire arms of this construction, the chambers are made around the periphery of a a short cylinder, say three inches and a half in diameter, and three fourths of an inch thick, said chambers being bored in towards the centre, and made somewhat conical. This is placed behind the barrel of the gun, so as to revolve horizontally when the gun is in a position for firing. Percussion caps are placed on nipples on the under side of the cylinder, there being suitable guards to prevent their accidental discharge. The following is the claim.

"What I claim as my invention in the within described many chambered fire arms, is the combination of a many chambered cylinder, the chambers of which are formed around the periphery in the way herein described, with a rifle, pistol, carbine, or other barrel, and combined also with the stock of such fire arm by means of the stock straps, connected substantially in the manner set forth. I also claim the combination of the percussion cap guard, together with the thin circular plate under it, with a cylinder constructed and connected as above set forth, for the protection of the percussion caps. I also claim the manner of connecting the barrel, in arms so constructed, with the rising piece of the under stock strap, by screwing it therein; the whole combined so as to constitute a fire arm substantially the same with the foregoing."

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77. For improvements in the *Many Chambered, non recoil, Fire Arms;* John W. Cochran, City of New York, April 29.

A principal object in the patent before us, is to construct the fire arms last described in such manner as to allow of the ready removal of a cylin-

der which has been exhausted, for one which is ready charged, by which means five or six cylinders contained in a belt, may be successively used, two or three seconds being sufficient to allow of the removal of one, and the substitution of another. For this purpose the upper stock strap, forming the upper side of the mortice, or opening, in which the cylinder is contained, is hinged to the back end of the barrel, so that it can be released by touching a thumb spring, thrown up, and the cylinder exchanged. A second improvement consists in leaving a space in the hinge joint of this strap, through which a portion of the fire and smoke which escapes between the cylinder and the barrel, may pass, this opening being immediately above their junction. The claims made are to these two distinct improvements.

It may be proper to observe that the application of Mr. Cochran for improvements in fire arms had been many months depending in the patent office, prior to the fire in December, 1836, when his papers and models shared the common fate of every thing contained in that department. Such also was the case with numerous other applications, and it is now noticed to account for the delay in issuing the patents, arising in the first instance from a desire on the part of the applicant to remodel his specifications in some particulars, and subsequently from the burning of the office.

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78. For an improvement in the *Spoke Shave;* Ira L. Beckwith, Quincy, Norfolk county, Massachusetts, April 29.

In this spoke shave there is a steel roller in front of the cutting edge of the knife, which roller turns freely on pivots at its ends; it extends the length of the knife, taking the place of the wood or metal which usually constitutes the front of the throat. The bearing of this roller is adjustable, so that as the knife wears away, it may be advanced towards it. A thin plate of steel, called a cap, is to be screwed on to the under side of the knife, to cause it to operate like a double iron plane, and shave against the grain. The claims are to these particular improvements.

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79. For an improvement in the *Joints of Carpenters' and other Rules;* Lemuel Hedge, City of Hartford, Connecticut, April 29.

This rule joint turns upon double centres, much in the manner of card table hinges, so that when the rule is closed the joint end will be square, like the two opposite, or opening ends. To insure the opening and closing correctly, there are two angular projections on the brass plates constituting a part of the joint, with corresponding shoulders, which though simple in construction, cannot be readily explained without a drawing. Since the patent for this joint was obtained, the same individual has obtained another for an improvement in it, which will come to be particularly noticed in due course.

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80. For an improvement in the *Spring Saddle;* Moses Baldwin, Cincinnati, Ohio, April 29.

The claim made is to "two thigh webs, and an additional pair of drawdowns; also the position of the springs and cantle plate; using for the purpose of making the two latter, iron, steel, or brass wire, varying in size to suit the weight of the rider."

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81. For improvements in the *Loom for Weaving various kinds*

of Fabrics; Christian W. Schonherr, of the kingdom of Saxony; patent dated March 31, but issued April 29.

Under the new Patent law, patents may be dated at a period prior to their issuing from the office, but not exceeding six months; this may account for some apparent discrepancies of dates in our lists.

This is a very ingeniously constructed hand loom, the description of which extends to a considerable length, and refers to numerous figures in the drawings; the particular construction of the parts claimed as improved cannot, therefore, be furnished in a brief way, but some idea of the design may be obtained from the claims, which are:

"*First.* The modes of actuating the treddles by levers and horizontal bands passing under pulleys, and springs, as described and set forth.

"*Secondly.* The arrangement of the picking straps, with the loop, or bridle, and horizontal check strings, leading to the spring lever; also the shuttle catcher bar, with its strap and spring rod.

"*Thirdly.* The mode of actuating the lathe, by means of a cam or tappet, together with the straps and their guide pullies, as also the spiral springs attached to the sword, for the purpose of drawing back the lathe as described.

"*Fourthly*, The arrangement of machinery as described, by which the giving out of the warp and taking up of the cloth is effected and regulated.

"*Fifthly.* The improved driving pulley as described, which, when the loom is turned by hand, may be made to act as a fly wheel.

"*Lastly.* The form of shuttle with the cavities described, and of the picker to be used therewith."

Specifications of American Patent.

Specification of a Patent for an improvement in the mode of securing or holding the cop on the tongues of Power Loom Shuttles; granted to Comfort B. Thorp, *Smithfield, Providence county, Rhode Island, April 17th,* 1837.

My improvement consists in a mode of more effectually securing and holding the cop, or woof, upon the tongues of the common power loom shuttle, than the mode now in use, preventing the cops, or woof, from sliding off from the tongues while weaving, especially the last part of them which so frequently slips from the common smooth tongues, and draw into the web, injuring the cloth, and wasting yarn.

My improvement consists of ridges, or parts jutting from the surface of said tongues, protruding into the cop, against which the innermost turns or coils of the woof will lodge and prevent the cops from sliding from the tongues.

There are various ways to form or produce such projections or protuberances, such as cutting notches in of a saw tooth form, the points or cutting part of which will stand towards the heel or pivot of the tongues, and about five eighths of an inch apart on each corner, and so arranged that neither of them will come opposite to another. The square of the tongue should be equal to the hole in the cop. Also by forming a worm, or spiral projecting lip or edge around the surface of the round tongues, or by cutting notches therein.

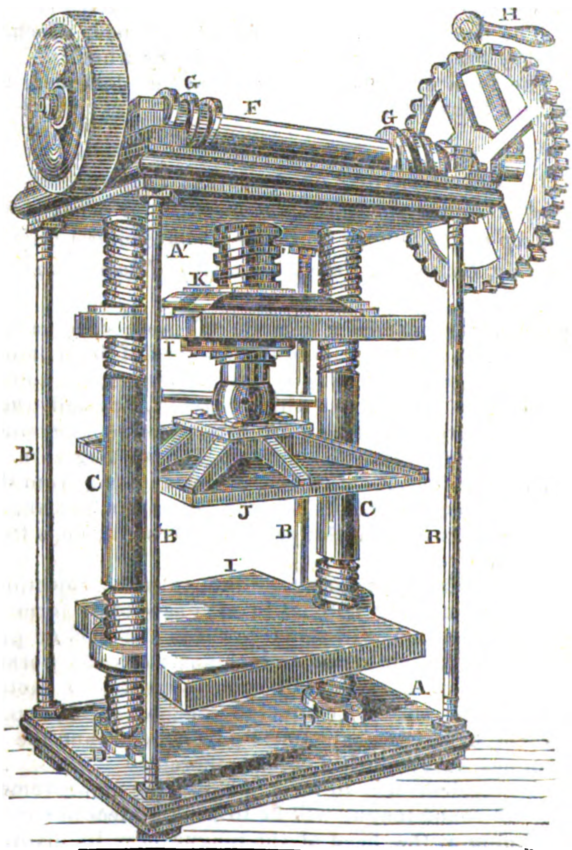
The most convenient way to form and use the improvement on the common smooth round tongue will be to wind a piece of wire around it, spirally, beginning at the head of the tongue near its pivot, and form-

ing about eight turns, more or less, onward towards the point, each turn should be three eighths of an inch apart, or thereabout. The wire should be the sixteenth of an inch in diameter, and confined to the tongue by soldering. It is necessary that the tongues should be made so small in size as to protrude into the cop with ease, before the wire is put on to said tongue. The most handy way to put the cop on to the screw tongue, will be to slip the cop on to its point until it comes to the worm, and then with one hand hold the cop and whirl the shuttle round.

What I claim as my invention, and desire to secure by Letters Patent, are the above described projections which protrude into the cop, for the purpose of more effectually securing and holding the cop or woof on upon said tongue. Also the application of the worm, or the spiral projecting lip or edge to the round tongue, as herein described, for the purpose of holding and preventing the cop from slipping off from the tongues of the shuttles while weaving.

COMFORT B. THORP.

Specification of a patent for a standing Press, granted to JOEL BARNS, *City of Philadelphia, April* 17*th* 1837.



To all whom it may concern, be it known, that I, Joel Barns, of the City of Philadelphia, have invented a new and improved Standing Press, to be used for the pressing of every kind of article to which such presses are adapted; and I do hereby declare that the following is a full and exact description thereof, reference being had to the drawings which accompany, and make a part of this specification.

A, A′, are the bottom and top plank, or plates, of the press, forming a part of its frame. B, B, are rods of iron passing through the top and bottom plates, and firmly secured to them by screw nuts, or otherwise. C, C, are two screw shafts, each of them having a right handed screw at one end, and a left handed screw at the other, a blank space, not formed into a screw, being left between them. These screw shafts pass through the plate A′, and revolve within a suitable collar; they also revolve in steps D, D, at their lower ends. A toothed wheel, or pinion, not seen in the drawing, is firmly fixed on each of these shafts, just above the upper plate A′, and a horizontal shaft F, carrying two endless screws G, G, which mash into the wheels or pinions, upon the screw shafts; G, G, when turned by mean of the winch H, or by a wheel and pinion, or any other suitable gearing, cause the screw shafts C, C, to revolve. I, I, are two plattens, or followers, having nuts, or screw boxes, on or within them, adapted to the screws of the shafts; and it will be apparent that by the revolving of the shaft F, these plattens, or followers, will be made to approach towards, or to recede from each other as may be desired. A third platten, or follower, J, has a screw K, attached to, and swiveling on it, in the manner of the ordinary screw press, the female screw or nut, within which it works, being fixed in the platten I; the upper end of this screw passes freely through a hole in the centre of the upper plate A′. The use of this platten is to save time by the ease and rapidity with which it may be raised or lowered, instead of raising or lowering the two plattens first named. To effect this with the greater facility, I usually make the thread of the screw K, considerably coarser than that on the shafts C, C, the power of the press being dependent, in a great measure upon the cutting the latter as fine as is compatible with the necessary strength.

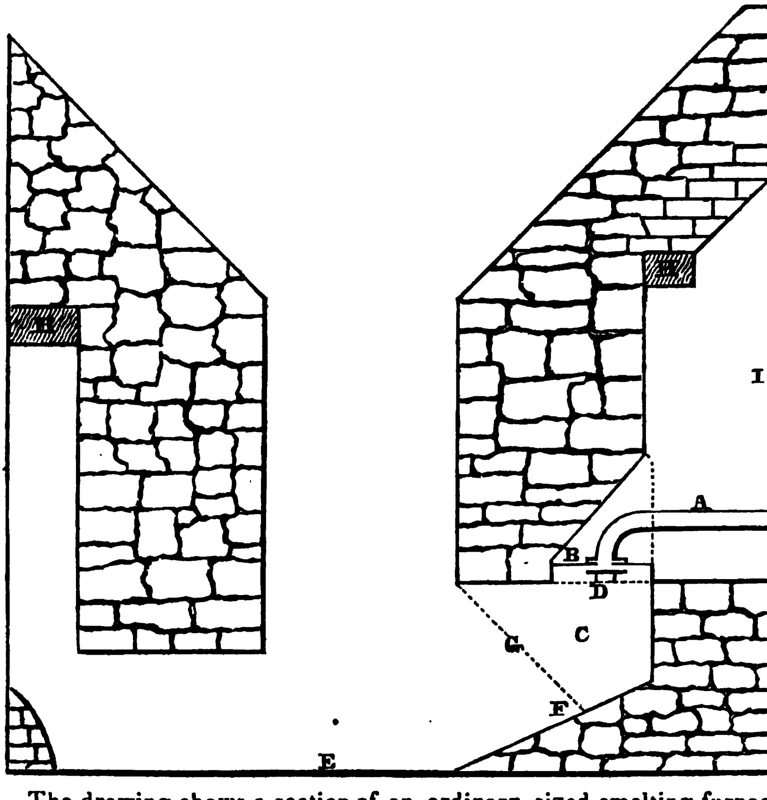
It has not been thought necessary to give any particular dimensions, or the proportions of the respective parts to each other, as these will vary with the purpose to which the press is to be applied, and can be duly adjusted by any competent workman.

Having thus fully described the construction of my newly invented press, and the manner in which the same operates, I do hereby declare that I do not intend to claim the mere application of a shaft with a right and left handed screw upon it, or either of the parts of the press described taken individually, and alone, as my invention, these being well known as elements of other machines; but what I do claim, and wish to secure by Letters Patent, is the combination of these parts constituting a press with three plattens, or followers, two of which are operated on by shafts having right aud left handed screws, turned by a gearing constructed and arranged substantially in the manner herein described, whilst the third platten is raised and lowered by means of an independent screw, in the manner herein fully set forth.

Joel Barns.

Specification of a Patent for an improved mode of applying the Blast to furnaces, granted to John Barker, *City of Baltimore, April 20th,* 1837.

To all whom it may concern: be it known, that I, John Barker, of the City of Baltimore, in the state of Maryland, have invented a new and improved mode of applying the Blast to Furnaces for the smelting, or fusing of metals, and which is particularly applicable to those erected for the manufacturing of iron: and I do hereby declare that the following is a full and exact description thereof, reference being had to the drawing which accompanies, and makes a part of this specification.



The drawing shows a section of an ordinary sized smelting furnace, and represents such part thereof, as is necessary to a clear understanding of my invention, which consists in a mode of introducing the air from the blowing apparatus diffusively, without impinging upon the ignited fuel as it does when introduced through the tuyere in the ordinary way; by which diffusion there is an essential difference in the results produced, the action of the air being from the very commencement of its introduction, by gradual and easy pressure.

A, represents the blow pipe, connected with the blowing apparatus,

and passing through the tuyere arch to the furnace. This pipe should not be less than three inches in diameter, but it may be made much larger, and its being so will rather aid than abstract from the result at which I aim; the quantity of air introduced through it, is altogether independent of its size, this being governed by the number of strokes made by the pistons, and the capacity of the blowing apparatus. From the blow pipe A, the air passes into a square, round, or other shaped box, B, made of sheet or of cast iron, the horizontal section of which may be a square foot, more or less, and its depth about two inches. The lower face of this box is preforated with numerous holes, through which the air is to pass into the chamber C, of the furnace, by which means the blast will enter over the whole area of the face of the plate. To prevent its impinging too forcibly upon the centre portion of the plate, a small plate D, may be placed directly under the blow pipe, so as to diffuse the blast; or a similar result may be obtained by making the perforations about the middle of the lower plate much smaller than towards its outer edges. The bed stone E, may be continued in a horizontal position under the chamber C, but I prefer to give it an inclination at that part, as shown at F, as this will dispose any matter in fusion to descend towards the middle of the furnace. When this part is constructed, as shown in the drawing, the coal and other materials in the furnace, as they descend, will assume a position near the chamber C, something like that shown by the dotted line G, leaving a clear space under the box B, for the admission and expansion of the air, which will consequently, be forced into the fuel by an equable pressure over a large surface, as intended by me. In the position given to the box B, also, there will be a perfect security against its being obstructed by the coal, or other matter within the furnace. There may be two or more blow pipes, operating in the way described, just as there may be two or more tuyeres when the blast is introduced on the ordinary plan.

Instead of the box, B, a trumpet mouthed pipe may be used, as may also other analogous contrivances to diffuse the blast in the chamber, which diffusion is the great object that I have in view; and for this purpose my furnace must always be so constructed as to have a chamber, operating like that marked C, free from fuel, through a space sufficient to allow a large surface to be exposed of that portion of the burning fuel into which the air from the blast is first to enter, which surface is represented by the dotted line G. In whatever way, therefore, the *proper quantity* of air is introduced, provided it be such as will allow of its *diffusion in a chamber*, constructed so as to operate like that marked C, before it comes into contact with the burning fuel, my purpose will be accomplished, and my invention adopted. This may be done even when the blast is introduced into the chamber by the common blow pipe although it should be directed towards the burning fuel, as the chamber is intended to equalize the blast before its contact with the burning fuel. The chamber C, for example, may be extended in height, by enclosing that part of the tuyere arch shown by the dotted line H, and blowing into it by the ordinary blow pipe which would then perform the office of the pipe A, the box D being removed.

Having thus fully described what I believe to be the best mode of attaining the end which I propose, namely, the introduction of the blast

into a furnace under an equable, but comparatively light, pressure, by diffusing it, at its entrance, over a large surface, without diminishing it in quantity, I do hereby declare that I do not intend to limit myself to any particular proportions, or dimensions of the parts of my apparatus, or to any precise location thereof; but I claim as my invention the diffusing of the blast *in a chamber* as it enters a furnace, in the manner, and for the purpose, herein set forth, whether the apparatus be constructed in the way described, or in any other which is substantially the same.

JOHN BARKER.

Specification of a Patent for a mode of constructing Furnaces for the smelting of Iron Ore by the use of hard, or anthracite coal; granted to SIMEON BROADMEADOW, *City of New York, April* 5, 1837.

To all whom it may concern: Be it known, that I, Simeon Broadmeadow, of the City of New York, in the State of New York, have invented a new and improved mode of constructing Furnaces for the smelting of iron ore by the use of hard, or anthracite coal, as a fuel, and I do hereby declare that the following is a full and exact description thereof.

The dimensions of the respective parts of my furnace, which I am about to give, are such as will designate one of ordinary size; my object therein being to afford a clear view of its general construction and arrangement, without intending to limit myself to the precise admeasurements set down, but rather to exhibit a general character by which any competent iron master will be enabled to see the difference between my furnace, and all those which have preceded it, and also to construct the same.

The whole height of the furnace, above the hearth, is twenty-five feet. The form of the stack above the tymp is that of two truncated cones, the bases of which unite at the middle of the stack, whence they regularly taper to the diameter of two feet at the top, and the same at the tymp. The tymp must be eighteen inches long and nine inches deep, as will be seen by the drawing (deposited in the patent office,) which is drawn upon a scale of half an inch to the foot. The hearth below the tymp, where the molten iron lies ready to be drawn off, is three feet square, and two feet deep; whence the slag, or dead cinders, are to be thrown off, as in other furnaces. I use two tuyeres, which at the inlet are each two inches in diameter. The pressure of the blast is two pounds and a half to the square inch.

Should the furnace much exceed the height designated, the weight of the anthracite, and of the ore, will be such as to obstruct the passage of the blast through the mass, and consequently to defeat the process; but by keeping to the proportions given, the pressure of the mass upon the tuyere will be moderated, and the blast will readily find its way to the top of the furnace, and a good working heat be attained.

In using such a furnace, I first heat it by putting in 300 bushels of charcoal; I then charge it by putting in 200 lbs. of hard coal, then 200 lbs. of iron ore, and fifty pounds of lime stone; repeating the charge as the materials sink, treating it in these particulars in the ordinary mode of managing furnaces for making iron. The ore is to be roasted, and otherwise prepared, in the ordinary way; and I of course vary the flux, and other things, according to the nature of the ore to be smelted.

What I claim as my invention, and wish to secure by letters patent, is the construction and employment of such a furnace as that herein described, for smelting iron by means of anthracite, or hard coal; that is to say, a furnace which is substantially the same with that described, in the general structure, proportion, and arrangement of the parts containing the ore to be smelted.

SIMEON BROADMEADOW.

Progress of Practical and Theoretical Mechanics and Chemistry.

A description of the most powerful electro-magnet yet constructed. By the REV. N. J. CALLAN, *Professor of Natural Philosophy in the R. C. College, Maynooth.*

I have lately constructed for the College, an electro-magnet which far surpasses in electric and magnetic power, all the electro-magnets of which I have been able to find a description. The iron bar of our magnet weighs 15 stone; it is 2½ inches in diameter, and more than 13 feet in length. It is bent into the form of a horse shoe; the distance between the poles is 7 inches. A copper wire ⅛ of an inch diameter is coiled once round the whole length of the iron bar. This wire is divided into 7 parts, each about 70 feet long. A thin copper wire about $\frac{1}{40}$ of an inch in diameter is soldered to one of the thick wires at about a foot from one of its extremities. The thin wire is about 10,000 feet long, it is wound round the magnet in the same direction as the thick wire, and in one continuous coil. By connecting the opposite ends of the seven thick wires with the opposite poles of a powerful galvanic battery, an extraordinary magnetic power is communicated to the iron bar; and, by breaking the battery communication, an electric current of enormous intensity is excited in the long coil of thin wire. I have tried the magnetic and electric powers of this magnet only once. In consequence of making the trial, in presence of about 300 of the students, I was compelled to omit many of the experiments which I intended to make, and which I expect to make before the end of this month.

In exhibiting the power of the magnet, I first used our large battery of 20 pairs of plates, each 2 feet square, and afterwards, a Wollaston battery containing 280 pairs of 4 inch plates. When the opposite extremities of the 7 thick wires were connected with the opposite ends of the battery of large or of small plates, we found it impossible to separate the keeper from the magnet by any force acting in a direction opposite to that in which the magnetic power was exerted. The keeper was a horse-shoe bar of iron about 20 inches long and 2½ inches diameter. The highest point of the arc formed by the keeper was 7 inches. The distance between its poles was the same as the distance between the poles of the electro-magnet. Its weight was about 28 pounds. When the electro-magnet was placed in a horizontal position, and the keeper applied to it, the magnetic power was so great (when the battery of large plates was employed) that the keeper remained without any support, in a horizontal position; and a weight of about 40 pounds, acting at 7 inches from the poles, or at the highest point of the curve formed by the keeper, was required to turn it out of the horizontal position. The

poles of the magnet were so badly ground that a great part of the keeper was at a sensible distance from the magnet.

The magnetic power produced by the 20 large plates was considerably greater than that which was communicated to the iron bar, by the 280 pairs of small plates.

The great electric power of the magnet, or its power of exciting an electric current in the helix at the moment battery connexion is broken, was shown by the most brilliant combustion of charcoal, and by the destruction of animal life.

To one end of the oscillating wire belonging to the electro-magnetic repeater, I tied with a fine metallic wire, a piece of charcoal, in such a way that, on working the repeater, the extremity of the wire and the point of the charcoal should dip simultaneously into the mercury, and should rise simultaneously from it. The opposite ends of the thick wires coiled on the electro-magnet were connected with the opposite ends of our large battery, and the connexion was broken very rapidly by means of the electro-magnetic repeater. As often as the connexion was broken the charcoal and mercury were ignited by the electric current excited in the thick wires coiled round the magnet. The succession of sparks produced by the ignition of charcoal and mercury, was so rapid that they formed one continued blaze of the most vivid light. The combustion of charcoal and mercury was accompanied by a large quantity of smoke, and was much more brilliant than that which is produced by a voltaic current passed from the battery employed, through a pair of charcoal points.

When, by means of an electro-magnetic repeater, a rapid succession of the electro currents excited in the long coil of thin wire, (at the moment of breaking battery connexion) was passed through charcoal points, they were but slightly ignited. But, although the igniting power of the electric current produced in the long coil of thin wire, was very feeble, its intensity was exceedingly great. For, when it was passed through the body of a large fowl, instant death was produced.

I have not as yet examined the decomposing power of our magnet; but I will shortly try it on some of the simple substances.

I found about four months ago, that an electric current capable of giving a shock, and consequently of producing decomposition, is excited in the helix of an electro-magnet on making, as well as on breaking battery connexion, when the thick wire coiled on the iron bar is short, and when the thin wire is long. Hence it is impossible to obtain separately the elements of bodies decomposed by the electro-magnet. For a similar reason it appears to me impossible to obtain separately the elements of substances decomposed by the magneto-electric machine. The shock given by the magnetic helix, on *making* battery connexion is weak compared with that which is given, on *breaking* communication. It increases with the number of plates in the battery.

I am now engaged in making an electro-magnetic engine to be worked by our large magnet, or by 26 smaller electro-magnets. Should the engine work well, I expect to send you a description of it, in time for publication in the October number of the Annals.

Maynooth College, June 14, 1836.

In a paper published in the July number of the Annals, I stated that I was then employed in making an electro-magnetic engine to be worked

by 26 electro-magnets. In the end of June, I tried the engine before it was completed, and found these two defects in it. The first was that some of the magnets were connected by iron where they ought to have been connected by a substance not susceptible of magnetism; the second arose from the number of magnets which were divided into two sets, each containing 13 magnets. I found it impossible in the plan which I adopted, to make an odd number of magnets work, and was therefore obliged to reduce the number of magnets to 24: or to two sets each containing 12 magnets. I also substituted a brass connexion between the magnets for the iron one. I then found that one small electro-magnet was capable of producing circular motion in a wheel which weighed about 100 pounds, and that six magnets were sufficient to give rapid motion to the wheel. The results of the experiments which I made, convinced me that electro-magnetism might be successfully applied to the working of machinery of every kind and I resolved to get made an engine which would do the work of one horse, or perhaps two. This engine will contain 40 electro-magnets, and I expect that, with a battery containing six square feet of zinc, it will propel, at the rate of 7 or 8 miles an hour, a carriage which along with its load, will weigh 13 cwt. The engine will be ready for work in the end of this month or in the beginning of next. By calculations founded on experiment, I have been led to the following conclusions. First, that an electro-magnetic engine as powerful as any of the steam engines on the Kingston Railway, may be constructed for the sum of £250; secondly, that the weight of such engine will not exceed two tons; thirdly, that the annual expense of working and repairing it will not be more than £300. If my calculations be correct, the expense of propelling the railway carriages by electro-magnetism, will be scarcely one fourth of the cost of steam. I have found that the first cost of an electro-magnetic engine, and the expense of working and repairing it, increase only as the square root of the power of the engine. Thus the first cost of an engine of 100 horse power, and the expense of working it will be very little more than ten times the cost of an engine of one horse power. A battery containing 10 square feet of zinc will work an engine 100 times as powerful as that which requires only one square foot of zinc.

N. J. Callan.

Maynooth College, September 11th, 1837. Annals of Electricity.

Temporary Caissoon for stopping out water while repairing sea-cocks of Steam Vessels.

The following description of a temporary caissoon, applied to H. M. steam-vessel Dee, for the purpose of excluding the water whilst one of the sea-cocks was ground in afresh, by Com. W. Ramsay, R. N., displays that ingenuity under difficulty, for which our seamen are celebrated:—

In describing a caissoon that was used by H. M. steam-vessel Dee, under my command at Port Royal, in the month of August, 1835, the simplicity of the details are such, that it may perhaps be thought by some hardly worthy the attention of the readers of the Nautical; but as all who may have to encountre a similar difficulty may not know how easily

it can be overcome, is a sufficient reason for giving them. It is necessary first to state, for the information of those who are not much acquainted with the fittings of steam-vessels, that there are several sea-cocks, which, when turned, admit the water through the bottom of the vessel for various well-known purposes. The most common plan is to have a pipe, which communicates with the sea. About a foot from the outside of the vessel is the cock, upon which another pipe is fixed which conveys the water to its destination. Now these cocks, by constant use, are liable to leak; when this occurs, the water flows in a stream into the vessel, and the only remedy to be applied is to remove the cock and what is technically called, grind it in afresh, and then replace it. This is, of course, effected without danger when the vessel is in dock, but it is evident, that if attempted when she is afloat, without some method of preventing the water rushing in, if the pipe inside cannot be stopped, which would be very doubtful, the vessel would fill with water.

This being premised, it may be now stated that the sea-cock on the larboard side of H. M. steam-vessel Dee was found to be leaking very much. It was considered that taking off the cock, and trusting to being able to stop the pipe from inside would be dangerous, besides the difficulty, perhaps impossibility, of putting the cock on again when reground, with such a rush of water as it is evident would take place. As there are no locks at Port Royal, the only plan was to stop the aperture (by which means the water enters the vessel) outside, until the necessary repairs were completed.

The vessel was first given as great a heel as possible to starboad, by which the hole to be stopped was brought within four feet of the water's edge; next, having procured several feet of two inch fir plank, a box was made which had three sides, and a bottom, of the following dimensions: the back was five feet deep by four broad, the sides three feet broad, the bottom of course extending from the back to the ends of the sides. The way in which it was rendered water-tight was this: two folds of very thick fearnought boiled in a mixture of tallow and tar was placed between each joining of the planks, and the whole was kept together by the means of iron bolts, which were driven quite through. Now, it was necessary to obtain the exact curve of the vessel's bottom, that the sides of the caissoon might be cut to answer to it. This was effected by means of a long stripe of lead, which was forced during a calm against the vessel's bottom. The curve being thus obtained, the sides and bottom of the caissoon were cut to their proper shapes; small grooves were cut in their edges, and four folds of fearnought, prepared as above, were nailed on. The nails were driven along the grooves. so that when the caissoon came to be pressed against the vessel's bottom, there might be nothing to prevent a good fit. Two large cleets were then nailed upon the vessel's side, on the exact spot that the top of the caissoon would be, so that once forced down into its place, it could not rise again. As near the surface of the water as possible, two strong screw eye-bolts were fixed to the vessel's side, through which lashings were rove, and a tackle got all ready.

The caissoon was now put over, forced down under the cleets mentioned above, the lashings encompassed it, which were hauled tight by the tackle by which means the caissoon was forced against the vessel. A small pump that had been prepared before, was then placed in it, by

the aid of which, and bailing, all the water was got out of the caissoon in about ten minutes, after which one man occasionally bailing kept it quite dry. Having this to work in, the aperture was soon secured, the cock taken off and ground afresh. When that was finished and put in again, the caissoon, which had been allowed to fill with water was pumped out, the lead and plank that had been nailed on to keep the water out of the ship, was taken off, and the whole business was finished without the slightest stop, impediment, or difficulty, in about forty-eight hours. Nautical Mag.

Hot Blast Iron.—British Association.

The *Manufacture of Iron* occupied a very large portion of the time of the section. The first paper on this subject was by Mr. G. Crane, of Ynyscedwyn Iron Works, on the smelting of iron by anthracite coal, of which fully a third of the immense coal field of South Wales, is composed. Mr. Crane had smelted a ton of iron with 27 cwt. of anthracite coal with very satisfactory results as to quality, and found a very considerable saving in using it in preference to bituminous coal. The smelting was now conducted by a cupola furnace, into which a stream of air was urged of heat sufficient to melt lead, this hot blast being all that was requisite to produce the combustion of the coal necessary for the reduction of the ore.

Dr. Thomson gave an account of the result of the experiments carried on at the request of the Association, on the *Comparative Advantages of Hot and Cold Blast Iron.* He had analyzed more than thirty specimens of the Glasgow ore selected with great care, the richest of which had a specific gravity of 3.056, with nearly 85½ per cent. of iron. The roasting of the ore before it was put into the furnace, in order to drive off the carbonic acid, reduced it 85 per cent. Formerly in smelting, ten tons of coal were used for the reduction of one ton of iron. In 1823, when the hot blast was introduced, 2 tons 19 cwt. only were required; 19 cwt. being consumed in heating the air and the boiler of the steam engine. Coals were therefore greatly economised by the hot blast, which produced a concentration of the combustion, and therefore melted the iron in a greater degree. A smaller quantity of lime was required for fusing the clay, and hence a greater quantity of cast iron could be obtained from a furnace in a given time. He had been, from the Carron Iron Works, which were of high reputation, supplied with specimens of No. 1 iron, made from hot and cold furnaces, and found the gravity of the cold blast less than that of the hot blast iron. One specimen of the hot blast iron, No. 2, contained 90½ per cent. of iron. From five specimens of the hot blast from different places, he had obtained a mean of 95½ per cent. of iron. Hot blast was decidedly purer than cold blast full five per cent., and they were of equal strength. The force required to break both sorts was the same, being 2040 lbs., where the iron was ⅜ of an inch thick. A chain of ⅞ths thick, forged from the hot blast iron, had stood the test of 22 tons 7 cwt., twelve tons above the Liverpool chain cable test. The saving in the coal by hot blast was two thirds. No phosphorus had been found in the iron analyzed by him.

Mr. Guest had found a much larger portion of the hot blast lost than of the cold blast in converting it into malleable iron. Mag. Pop. Sci.

Upon the Affinity which the Fluids of living organized Structures have for Water. By M. de Blainville.

Naturalists have long observed how much the hygrometrical and statical condition of the atmosphere; in other words, how much its moisture and weight, exerts an influence over the life of animals, influencing their form, whether small, sleek, and elegant, or on the contrary, heavy, lumpish, and swollen, according as this medium of existence is dry and in brisk movement, or on the reverse, saturated with humidity and stagnant, as is well exemplified by comparing together the inhabitants of Holland and Andalusia. They have also noticed that the habitual use of free potations and watery viands, or on the contrary, very nourishing and dry food, have a manifest effect on the condition of man and animals. As, however, these different results require a longer or shorter time before they take effect, their mode of action, we conceive, cannot be so manifest as it was on the occasion of an observation made in Egypt by M. P. E. Botta, a naturalist connected with the Natural History Museum of Paris, and now travelling in Arabia Felix. His remark is this: Camels, as is well known, are the only means of transport which can be employed in traversing the vast deserts which are encountered in many parts of Africa and Arabia, and this on account of their nature, and still more their habits in which they are reared from their youth, in virtue of which they acquire a power of abstinence to an extraordinary extent, being enabled to refrain from eating, and especially from drinking, during almost an incredible space of time. Here, however, we may remark in passing, that this remarkable power is not to be attributed to the circumstance that these animals are provided with a sort of stomachic reservoir, in which they husband their supply of water, as has been long alleged, and is still repeated in many of our modern publications, but is owing merely to the great extent of the salivary apparatus, which in all animals has a development in the ratio of its common food. Now, during the long journeys across the portion of the great desert which begins or ends at some distance from Cairo, according as you ascend or descend the Nile, M. Botta had occasion to observe that these camels, in proportion as they proceeded from the place of departure, became thin with a rapidity which was very striking and remarkable. He had also occasion to confirm an observation which was made ages ago, that these animals really seemed to smell water at incredible distances, which is inferred from the increased swiftness in the speed of the camels; which, in spite of their enfeebled power, during the progress of a protracted journey, redouble their efforts as they approach the spots where water is found, in hopes of obtaining that refreshing draught which can alone satisfy their thirst and relieve their torments. So soon as these animals reach one of those springs so sparingly scattered over the desert, they throw themselves into it with avidity, and though more or less muddy, they continue drinking it for a long time. That which most of all astonished M. Botta was the almost instantaneous change which this treat produced in them. In fact, after having been in this way reduced to the worst and most meagre condition, after the expiration of a short period of repose, and having drank well, they rise in so much apparent flesh and good condition, that you could scarcely believe them to be the same animals. Since, therefore, there was no other change in their regimen than the introduction into their stomach of a handful of

dry nourishment, and of a great quantity of water with which they had just before gorged themselves, it is clear that this alteration in their condition, so sudden and so apparent, can be attributed only to the introduction of the watery fluid first into their stomach, then into the circulating fluids, and, finally, into the cellular tissue, in consequence of a true act of imbibation through the continuity of substance, whether circular or capillary, as in a sponge, and perhaps also by that process which is now denominated *endosmose;* that is to say, by the affinity which the liquids of a living organized part have for moisture, after they have been deprived of it by great exhalation. Ed. New Phil. Jour.

Miners' Patent Safety Fuse.

In our present number will be found a brief report of an application made to restrain a party from manufacturing the "Miners' Patent Safety Fuse," which article we have had frequent occasion to notice as being one of the most important and useful inventions connected with mining.

We shall endeavor briefly to describe its properties, and thus enable those who have embarked in mining pursuits to judge of the value to be attached to the use of the "fuse," while its safety is in itself one of its strongest recommendations.

The "Patent Safety Fuse" is devised for safety and certainty in conveying fire to the charge in blasting rocks and in mining. It is in appearance like a firm varnished cord, just the size of a large goose quill, and has in its centre a continuous column of the best gunpowder—for convenient carrying and packing, it is manufactured in lengths, of twenty-four feet, coiled up like rope, the smallest coils being about three, and the largest about fifteen inches in external diameter, so that the different sized coils fall into each other and pack closely into small kegs or casks. It is so hard and firm in its texture, as to resist the action of tamping, is impervious to water, can be easily cut with a knife to any length, burns regularly in a measured time, conveying the fire at the rate of half a minute to the foot, and will act as certainly in a close rock firmly tamped up under twenty fathoms of water as on dry ground and in the open atmosphere.

The great advantages resulting from the use of this instrument have been acknowledged wherever it has been used. It offers protection to the workmen engaged in this hazardous employment; in large mining districts, where mutilation and death were frequent from premature explosions, accidents now very seldom occur. Its use occasions no trouble, but in comparison with every other mode greatly facilitates the operation. It is not only cheaper and more effectual than every other thing used for the purpose of certainly and slowly conveying fire to the charge, but is absolutely cheaper than blasting with the needle and straw, by saving a great portion of the powder necessary for the charge.

The Safety Fuse has consequently been long used in all the Cornish mines; has been strongly recommended by John Taylor, Esq., F. R. S., &c., Colonel Burgoyne, chairman of the Board of Public Works in Ireland, Mr. Purdy, secretary of the Mining Association of Ireland, and many distinguished scientific and practical gentlemen, connected with mining operations.

We can with justice add our testimony to its value, and do not hesi-

tate to recommend its general adoption. We have before observed, that specimens of it may be seen at our office, or will with pleasure be transmitted to parties interested. *Mining Journal.*

On a New Rain Gauge.—By the Rev. Thomas Knox.

On the 26th of June last, a new rain gauge was exhibited to the Royal Irish Academy, contrived by the Rev. Thomas Knox.

The object of this instrument is to register the amount of rain that falls when the wind is in different points. Its construction is very simple. The water—instead of descending from the reservoir directly into the tube of registry—passes through a lateral tube into an annular-shaped vessel, divided into eight compartments, each of which terminates below in a graduated glass tube. It is obvious, then, that if the eight tubes be set to correspond with the cardinal and intermediate points, and that the reservoir be made to revolve on a vertical axis by means of a vane, the direction of which corresponds with that of the lateral tube, the object proposed will be attained. Mr. Knox has preferred to make the reservoir fixed, and the system of tubes movable; but the result is obviously the same. *Lon. & Ed. Philos. Mag.*

On an Easy Method of preparing Platina Black.—By M. Döboreiner. *Translated for this Journal, by* John Griscom.

Melt platina ore (crude platina) with double its weight of zinc, and treat the alloy thus obtained and reduced to powder,—first, by dilute sulphuric acid, and then by dilute nitric acid, in order to oxidate all the zinc. This, contrary to theory, is but slowly effected, even at a high temperature. A dark grey insoluble powder of native platina remains, mingled with osmiuret of iridium. This powder acts like platina black, after it has been properly purified by lixivium of potash, and it has such an oxidizing action that it transforms not only formic acid into carbonic, and alcohol into acetic acid, but even the osmium which it contains absorbs oxygen from the air, and is disengaged by degrees in the state of osmic acid.

This method of preparing platina in an extremely divided state, was recommended by Descotils thirty years ago, and he was the first to observe that the powder thus obtained detonates by heat like gunpowder, and that muriatic acid destroys this property.

When platina powder prepared by zinc is moistened with alcohol, it becomes incandescent and osmic acid is disengaged; but if it be mixed with alcohol so as to form a paste, and spread out on a watch glass, it disengages only acetic acid. This is the most simple process of purifying the air of a chamber. *Jour. des Mines.*

A process of purification rather too troublesome and expensive when ventilation and lime can be easily resorted to. It may, perhaps, be eligible in a sick room. Tr.

Progress of Physical Science.

Method of producing a Permanent Soap Bubble, illustrating the colours of Thin Plates. By Dr. J. Reade.

The first account of the colours produced by thin plates is to be found in Mr. Boyle's works: "To show the chemist that colours may be made to appear or vanish, where there is no accession or change either of the sulphureous, the saline, or the mercurial principles of bodies, he says that all chemical essential oils, as also good spirits of wine, by shaking till they rise in bubbles, appear of various colours, which immediately vanish when the bubbles burst, so that a colourless liquor may be immediately made to exhibit a variety of colours and lose them in a moment without any change in its essential principles: he then mentions the colours that appear in soap bubbles, and also in turpentine. He sometimes got glass blown so *thin* as to exhibit similar colours." Here we may remark, that although Mr. Boyle did not advance any theory from these experiments, yet it is evident that he connected the production of colours with the thinness of the substance, as appears from his endeavours to blow glass sufficiently thin. This suggestion in all probability afterwards gave the idea to Dr. Hooke, and finally to Sir Isaac Newton, who has the merit of clothing Hook's suggestion in a mathematical dress, beautiful and interesting in the extreme.

Dr. Hook was the next to investigate this subject; at a meeting of the Royal Society, 7th March, 1672, he promised to exhibit at their next meeting something which had neither reflection nor refraction, and yet was diaphanous; he then produced a bubble of soap and water. It was no wonder that so curious an experiment should excite the interest of one of the most learned, liberal and scientific societies in Europe; they requested him to bring an account of it in writing at their next meeting. "By means of a glass pipe he blew several small bubbles out of a mixture of soap and water, when it was observable that at first they appeared white and clear, but that after some time the film growing thinner, there appeared upon it all the colours of the rainbow, first a pale yellow, then orange, red, purple, blue, green, with the same series of colours repeated." Sir Isaac Newton's experiments as exhibited in his Optics are so well known, that I shall not enumerate them in this paper, merely remarking that his bubble was so evanescent that it burst before he had time to make an accurate examination. Melville of Edinburgh thought to make a permanent soap film by means of freezing. This was impossible. It occurred to me that by taking off the atmospheric pressure, I might accomplish my purpose; I therefore made the following experiment.

Exp.—Having put two ounces of distilled water into an eight ounce phial, and having added about the size of a large pea of Castile soap, I placed the bottle in a saucepan of boiling water on the fire; the bottle was speedily filled with a dense volume of vapour, which expelled all the air. I now corked it, and after cooling, and thus condensing the vapour, had perhaps as perfect a vacuum as could be formed, even by the best air pump.* I now held the bottle laterally between my hands, and by means of a circular and brisk motion formed a circular film, on which

*This vacuum, we apprehend, may be vitiated by the entrance of atmospheric air through the cork, indicating the necessity of covering it with cement.—Edit. Mag.

by resting the bottle on an inclined plane, were formed after a short time all the parallel bands or series of colours in the following order: 1. a white or silvery segment at top; 2. a snuff-coloured brown inclining at bottom to a deep red; 3. blue; 4. yellow; 5. red; 6. blue; 7. green; 8. red: 9. green; 10. red; 11. green. (See Figures below.)

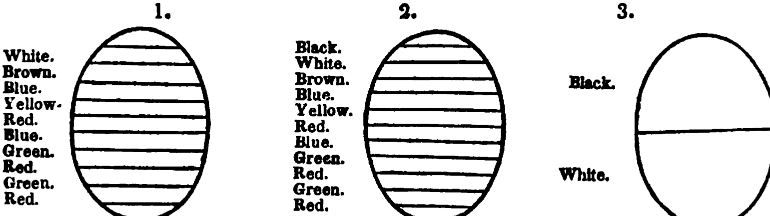
After some time a black segment was seen to form at the top of the white and continually to increase in size. After a few minutes the parallel bands increased in breadth, and running into one another only three or four distinct bands were seen. Nothing can exceed the beauty of these colours, equal to those of the rainbow, or the plumage of the tropics: whilst writing this description I have these bands in a bottle before me, feasting my eyes on their beauty. In a few minutes more this black segment of aqueous film occupies, perhaps, half the circular film, and the lower half becomes white tinged with orange.

If we now incline the bottle towards the experimenter's breast, the saponaceous atoms producing these colours are seen to float in the region of the black or aqueous: when placed again on the inclined plane they fall to the bottom of the films. In some time more the entire film becomes black, and all the colours disappear.

Having now placed the bottle in a basin of boiling water the evaporation was increased, and the black film soon became clothed with saponaceous atoms, which being variously condensed produced all the colours of the clouds when the sun is setting on a summer's evening. On again placing the bottle on the inclined plane the parallel bands were again formed by the attraction of cohesion, and the colours afterwards gave place to the black film. I held the bottle laterally between my hands, and by means of a circular motion washed it, and thus clothed it with saponaceous atoms, which went through the same process on placing the bottle on the inclined plane. By means of washing the film every morning, I preserved it for more than three weeks. This simple experiment opens a wide field of investigation to the natural philosopher, and enables him at his leisure to examine the interesting phenomena of these colours.

London, Sept. 4, 1837.

1. 2. 3.



Lon. & Ed. Phil. Mag.

On the luminous properties of Chloride of Calcium, by CHARLES TOMLINSON, ESQ.

When chloride of lime is subjected to a red heat in a Hessian crucible, it undergoes the watery fusion and is gradually decomposed. Chlorine is at first evolved, then oxygen; and chloride of calcium remains in the crucible. This substance, when thus treated, emits a pale green phosphorescent light, visible in the dark, and was formerly called on

this account, ***Phosphorus of Homberg***, this chemist being the first to record the fact.

But when the chloride of lime is completely melted in its water of crystallization, if the crucible be removed to a darkened room and allowed to cool gradually, not only does the phosphorescent light remain for many minutes, but large and distinct electric sparks and corruscations are visible, accompanied by a crackling noise due probably to the sudden contraction of the mass, or to its crystallization.

These phenomena can also be seen in the dark by dipping a glass rod into the fluid, a large portion of which concretes around it, and can be withdrawn with the rod.

When the contents of the crucible have cooled down, and all phosphorescence has disappeared, the sparks can be obtained most admirably by striking the cloride with a sharp instrument of any material; by simply scratching it; or by snapping a piece asunder; or by percussion with a hammer; and both sparks and phosphorescence can be obtained by grinding the substance in a mortar, and the luminous effects remain for a few seconds after the grinding is discontinued.

The colour and intensity of the sparks thus produced seem to vary with the degree of mechanical force employed; thus, a gentle scratch produces green sparks; a firm scratch, yellow green; a blow with a sharp instrument, yellow; snapping a piece asunder also affords a yellow spark, and a smart blow with a hammer affords a spark of an orange colour.

All these effects are best seen with the newly fused chloride; it absorbs water by exposure to the air and its electrical properties gradually decline; I have, however, obtained the sparks from it after a few day's exposure, but they were wanting in the brilliancy which characterize those obtained from the substance when newly fused.

The term *phosphorescence* seems to be a very bad one and calculated to mislead; since it is highly probable that all recorded instances of phosphorescent minerals, &c. (except, of course, phosphorus itself and its compounds) are due to electricity. It has been shown by Dessaignes that metallic bodies are capable of electric excitation by the simple processes of heating and cooling. Morgan has shown that there is no fluid nor solid but may be rendered luminous by the transmission of an electrical discharge through its substance; and that the difficulty of producing this appearance in all bodies increases as the conducting power of the body decreases. Skrimshire has given a long list of minerals, in which calcarious bodies occupy a conspicuous part, which become phosphorescent by the electrical discharge; and Brewster also has a long list of mineral substances which become phosphorescent by heat. Now the appearance of the hot chloride of calcium is similar to that of white sugar, immediately after an electrical discharge has been transmitted through it. All calcarious substances present this appearance in a high degree when similarly treated, and the exciting cause is probably the same; for whether we employ the electrical battery or the hot crucible, heat is communicated to the substance, and heat is favourable to electrical excitation. A piece of lump sugar, mica, &c. when suddenly snapped asunder, and cotton cloth when suddenly torn, show the electric spark; so also does the fracture of the chloride of calcium. An enquiry, therefore, seems to be wanting into the connexion between

phosphoresence and electricity since it is manifest that the appearances attending the slow combustion of phosphorus, and the light emitted by certain minerals when heated, &c. though similar in appearance are due to very different causes.

Salisbury, March 4, 1837. Annals of Electricity.

Atmospherical Phenomena.

M. de le Rive read a second paper "On an Optical Phænomenon observed at Mount Blanc." When the sun has set at Geneva, it is observed that Mount Blanc remains illuminated by its direct rays for a much longer time, than the surrounding mountains. This phænomenon is owing to the great height of Mount Blanc. But after it had ceased to be illuminated, the summit of Mount Blanc sometimes appears at the end of ten or fifteen minutes, less intensely enlightened than at first, but nevertheless in a manner very decided, and often very brilliant. This phænomenon takes place especially when the atmosphere is very pure—highly charged with aqueous vapour in an invisible state—and, consequently, very transparent. The author has satisfied himself (by the exact observation of the time which elapses between the two successive illuminations of the mountain, combined with the calculation of the sun's progress) that the phenomenon is due to the rays of the sun which traverse the atmosphere at a distance from the earth less than the height of Mount Blanc, but greater than half that height, and which arrive at rarer regions of the atmosphere under an incidence so great that they are reflected instead of refracted. This interior reflection is facilitated by the humidity of that part of the atmosphere which the rays traverse until they reach the point of incidence. The reflected rays falling on the snowy summit of Mount Blanc, produce this second illumination; and the humidity (by augmenting the transparency of the air) renders the illumination more brilliant.

Sir D. Brewster stated, that he had witnessed a similar effect, though on a less magnificent scale, on the Grampian Hills; but he had always observed, that on such occasions the sun set in a red west, and that all the clouds in that quarter of the heavens were then red.—M. de la Rive replied, that the phænomenon he spoke of only appeared when the sky was quite free from clouds, and, in truth, it was most brilliant when the air was very transparent in consequence of its being loaded with vapour in its elastic state.—Professor Lloyd said, that the distinctness and vividnes with which distant objects were seen in some states of the atmosphere, was quite astonishing; on one occasion, he had seen from the neighbourhood of Dublin the Welsh hills from their very bases, and brought so near, apparently, that he could absolutely see the larger inequalities of the surface upon the sides of the mountains. That the atmosphere was at that time very much loaded with vapour in a highly transparent state, was obvious from the fact, that immediately after, a very heavy fall of rain took place, and continued for a considerable time. Professor Stevelly wished to confirm what had fallen from Professor Lloyd and M. de la Rive, by stating that whenever the Scottish hills appeared with that peculiar vividness and distinctness from the Lough of Belfast, the fishermen always looked upon it as a sure precursor of heavy rain and wind. A friend had informed him, that on one occasion he

had noticed this appearance while standing on the beach at Hollywood, and pointed it out to an old fisherman; the old man immediately gave notice to all his friends to whom he had access, who instantly set about drawing up their boats and placing their small craft in more secure places; early the next morning a violent storm came on, which did much damage on the coast, to those who had not been similarly forewarned. Thus we find that the most interesting pursuits of the man of science, and the most important concerns of man in the practical details of life, frequently approach, and each may lend important aid to the other.—Mr. Lubbock was of opinion that the principal fact mentioned by M. de la Rive would receive a simple solution, if we admit the theory of Poisson regarding the constitution of the atmosphere. That eminent mathematician conceived that analysis led irresistibly to the conclusion that the upper portions of the atmosphere were, by the extreme cold there existing, condensed into a liquid, or even into a solid: if this were so, we could easily conceive how the reflection of the light from its under surface would re-illuminate the top of Mount Blanc after the direct light of the sun had ceased to reach it.—Sir David Brewster expressed much surprise at hearing, for the first time, of this theory of Poisson, and that he should feel much obliged to Mr. Lubbock if he would give some details of it in a separate communication to the Section; and he had little doubt but that it would be as new and acceptable to many gentlemen as to himself. He thought that the near apparent approach of distant objects in certain states of the air, as mentioned by Professor Lloyd and Professor Stevelly, might perhaps be accounted for by supposing that on these occasions the intervening air became actually converted into a large magnifying lens. Brit. Ass. for Adv. of Sci.—Mechan. Mag.

British Association.—Corrosion of Iron by Salt Water.—Singular action of Nitric Acid on Metals.

Mr. Hartley read a paper "On the corroding of Iron by Salt Water." The object of the paper was to shew that brass protects both bar and cast iron in a very perfect manner. The brass did not appear to have undergone any action, which, as stated by the President, Dr. Faraday, is rather opposed to received notions of electro chemical action.

Dr. Andrews next read a paper, "On some Singular Modifications of the Ordinary Action of Nitric Acid on certain metals." Bismuth in nitric acid of specific gravity 1.4, was rapidly acted upon, but this action immediately ceased when the bar was touched by platinum. On removing the platinum from the liquor, the bismuth will sometimes begin again to dissolve; at other times, its surface will become covered with a black crust, which is soon removed by the acid; but the metal, though now exhibiting a beautifully polished surface, is no longer acted upon by the acid, or, at least, is dissolved only with extreme slowness. Thus, a slip of metal, which in its ordinary state will require only a few seconds to complete its solution, will, when thus slightly modified, resist, for many hours, the action of the same acid.

Copper and tin present similar phænomena, but zinc, when treated in the same way, has its oxidation and solution not arrested, but merely retarded. Arsenic was found to present a singular anomaly when heated in nitric acid, so as to give rise to effervescence: the contact of plati-

num in the usual way did not produce any effect, whereas, when an acidulous solution of silver is used, platinum exercised its usual influence.

In the case of six metals, platinum checks the action of nitric acid, and three of them appear to be brought into a permanently peculiar state opposed to chemical action. Platinum always separates any film of oxide as its initial function, but after its separation, it exercises a polarizing action; for example, it brings the other metal into a peculiar state, which enables it to resist chemical action.

On the conclusion of this paper, the President drew the attention of the Section to the analogy between the facts detailed by Dr. Andrews, and the preservation of iron by brass, as instanced in the communication of Mr. Hartley. In both cases, according to the known laws of electro-chemical action, effects, the very opposite of what are observed, should present themselves. The bismuth, copper, &c., should oxidize quickest when in contact with the platinum; and if, as would seem demonstrated by Mr. Hartley, brass protects wrought and cast iron, the brass itself should be acted upon with increased rapidity. The solution of these anomalies, he conceived quite within the range of science in its present state, and he urged upon the members of the section the necessity of studying the phenomena in question, as their explication would constitute a very valuable addition to the existing state of our electrical knowledge.

Mec. Mag.

Mechanics' Register.

Origin of Amber. By H. R. Goppet.

This substance was found at Muskaur, in large quantity in fossil wood, belonging evidently to the genus Abus, and in other specimens very nearly allies to the genus Larix. They are all found in the brown coal formation. Amber likewise occurs in coniferous plants, associated with ferns in the coal of Wening-Rackvitz. Since, then, it appears that we already know four different species of tree which afford amber, (and the number would doubtless be increased by attentive investigation,) the probability seems to me to be rendered still stronger, *that amber is nothing else than an indurated resin derived from various trees of the family of the Coniferæ; which resin is found in a like condition in all zones, because its usual original depositories, viz. beds of brown coal, have been formed almost every where under similar circumstances.*

Edin. New Philos. Jour.

Sir Isaac Newton's Manuscripts..

An erroneous statement having found its way into the newspapers, respecting the purchase of Sir Isaac Newton's MSS. by the Royal Society, we are authorized to state that it has no foundation whatever. In consequence of Sir David Brewster being at present engaged in a large work on the life, writings, and discoveries of Sir Isaac Newton, he was kindly permitted by the trustees of the Earl of Portsmouth to examine the valuable collection of MSS. at Hursbourne Park. With the assistance of H. A. W. Fellowes, Esq., the accomplished nephew of Lord Portsmouth, many interesting and important letters and papers

were discovered, which not only throw much new light on the early life and studies of our immortal countryman, but tend to refute the groundless rumours respecting a temporary derangement of his mind in 1692, and to exalt, in the highest degree, his moral and intellectual character.—*Morn. Chron. June 27.*

Lon. & Ed. Philos. Mag.

New Waggon Steam Drag.

Mr. Boydell, of Dee Cottage, near Chester, has invented a locomotive engine, which, when fixed to heavy waggons, &c., will propel them on common roads at a very rapid rate. It was exhibited on Tuesday, and elicited the strongest approbation from many scientific and practical men who witnessed the trial, and minutely examined the machinery. It is applicable to ploughs, which it propels with great ease and velocity.

Chester Courant.—Mec. Mag.

Paris and Brussels Railway.

The railway which has long been projected for uniting the capitals of France and Belgium, at length bids fair to be commenced in good earnest. The king of the French has just granted to Mr. John Cockerell, the celebrated English iron master of Leige, the "concession" of the railway for fifty years. The French government is to advance 25 per cent. of the cost, on the distance from Paris to the Belgian frontier; and Mr. Cockerill is to be entitled to all tolls and profits for the first half century, when, it is to be presumed, the works will become the property of the nation. The only condition with which the grant is accompanied, is, that the toll for the French portion of the railroad shall never exceed *fifteen* francs, or 12*s.* 6*d.* The terms of concession were not agreed to until after the "high contracting parties," Louis Philippe on one side, and Mr. Cockerill on the other, had had several personal interviews. The latter must be allowed to possess a most adventurous spirit; he was a severe sufferer by the revolution at Brussels in 1830; and yet, it seems, is not deterred from adventuring his capital on a soil like that of France, which in fifty years may experience, probably, half as many revolutions.

Mec. Mag.

The Thermo-electric Spark, obtained from a single pair of Metallic Elements. *By* Mr. Francis Watkins.

With a pair of metallic elements, consisting of one bismuth and one antimony, weighing each five grains, and measuring 0.5 of an inch long, and 0.12 diameter, when their extremities were unequally heated, I have obtained, with a Henry's flat ribbon coil, a very perceptible and brilliant spark.

Now I have pen in hand, permit me to state that with thermo-piles I actuate most of the apparatus usually employed for illustrating electro-magnetic phænomena, so that the public teacher may now show by the same apparatus the several rotations, &c., with thermo-electricity, as he does with voltaic electricity. Lon. & Ed. Philos. Mag.

Celestial Phenomena for March 1838.

LUNAR OCCULTATIONS FOR PHILADELPHIA, JANUARY 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
4	10	0	Im. of *c* Aurigæ	,6,	64°	125°
4	11	16	Em. ‘		272	333

Meteorological Observations for October, 1837.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer Sun rise.	Barometer 2 P.M	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches	Inches			Inches.	
	1	60°	69°	29.80	29 84	W.	Moderate.		C'ear—do.
	2	54	71	29.95	29.90	W.	do.		Clear—lightly cloudy.
	3	55	64	29.96	30 0	W.	do.		Partially cloudy—do. do.
	4	46	54	30.10	30.15	W.	do.		Cloudy—clear.
	5	36	57	30.20	30.00	S.	Brisk.	.7	Clear—frost—cloudy—rain.
	6	52	56	29.80	29.80	N.	do.	.24	Partially cloudy—rain.
☾	7	40	58	29.95	29.97	W.	Moderate.		Clear—partially cloudy.
	8	45	54	29.97	30.10	NE.	Brisk.		Partially cloudy—do. do.
	9	36	51	30.35	30.40	NE.	do.		Partially cloudy—cloudy.
	10	46	64	30.26	30.14	NE.	Moderate.		Cloudy—do.
	11	51	70	30. 5	30. 5	W.	do.		Clear—do.
	12	55	72	30. 5	29.90	W.	Brisk.		Partially cloudy.—do.
	13	42	44	29.80	30. 5	NE.NW.	do.	.16	Rain—do.
☉	14	30	60	30.25	30.20	NW.	do.		Clear—do.
	15	36	59	30.20	30.20	W.	Moderate.		Clear—do.
	16	50	62	30.10	30.15	W.NW.	do.		Partially cloudy—do. do.
	17	45	64	30.31	30.22	W.	Calm.		Clear—cloudy.
	18	54	56	30.00	30.00	SW.	do.		Cloudy—clear.
	19	57	70	29.80	29.90	W.E.	Moderate.		Clear—do.
	20	55	66	29.85	29.70	SE.	Brisk.	.2	Cloudy—rain.
☽	21	48	58	29.86	29.95	W.	do		Cloudy—do.
	22	44	63	30. 5	30. 5	NE.SW.	Moderate.		Partially cloudy—clear.
	23	50	75	29.95	29.90	W.S.	do.		Clear—do
	24	55	76	29.90	29.85	W.	do.		Fog—clear.
	25	60	67	29.85	29.85	SE.	do.		Fog—cloudy.
	26	56	59	29.84	29.85	E.	Brisk.		Cloudy—do.
	27	45	49	29.84	29.86	NE.NW.	do.		Rain—cloudy.
	28	36	50	29.95	29.95	W.	do.		Clear—cloudy.
⊗	29	32	42	30.00	30.00	NW.	Blustering.		Coudy—clear
	30	29	47	29.83	29.90	NW.	Brisk		Cloudy—cloudy.
	31	36	15	30.00	30.00	NE.	Modrate.		Clear—do.
	Mean	46.45	59.93	29 99	29.99			.49	

	Thermometer.	Barometer.
Maximum height during the month	76.00 on 24th.	30.40 on 9th
Minimum do.	29.00 on 30th.	29.70 on 20th
Mean do.	53.19	29.99

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Practical and Theoretical Mechanics and Chemistry.

On Hydraulic and Common Mortars. By General Treussart, *Inspecteur du Genie. Translated from the French by J. G. Totten, Lt. Col. of Eng. and Brevet Col. United States Army.*

(Continued from p. 35.)

Article vii.—*Various Experiments on Mortars placed under water.*

Much importance has been attached to the manner of slaking lime. Mr. Lafaye published in 1777, a memoir in which he gives, as a secret recovered from the Romans, the mode of slaking lime by plunging it into water for a few seconds, and then withdrawing it to slake and fall to powder in the air. This powdered lime is preserved in a covered place Other Engineers have asserted that there is great advantage in stifling lime as it slakes; that is to say, covering it with sand before it begins to slake, in order to retain the vapours liberated during the process. Mr. Fleuret attributes great efficacy to this vapour, for he says "This vapour awakens and excites the appetite of the workmen, whence I conclude that it contains principles proper to the regeneration of lime and consequently to the hardening of mortars. But it is proved that nothing escapes but the vapour of water accompanied by some particles of lime. I made, on this point, the experiments contained in the following table.

Table No. XXV.

No. of the mortars.	Composition of the mortars.		No. of days required to harden in water.	Weight supported before breaking.
			days.	lbs.
1	Obernai lime slaked to powder with 1-5 of its volume of water being left in the air . .	1		
	Sand	2 } 3	15	176
2	Lime the same, slaked to powder with 1-5 of its volume of water being covered with sand . .	1		
	Sand	2 } 3	15	176
3	Lime the same, slaked by being plunged in water for 50 seconds .	1		
	Sand	2 } 3	15	154

Observations on the Experiments of Table No. XXV.

To make the three experiments above, I took a piece of Obernai lime which I divided into three portions. The first portion was slaked by throwing on one fifth of its volume of water, leaving the lime at rest in the air for twelve hours before making it into the mortar No. 1. The hardening was slow because the experiment was made in November.

No. 2 was slaked in the same manner with this difference, that I covered the lime with the sand as soon as I had thrown on the water. This, also, was left to itself for twelve hours before making it into mortar. These two experiments gave, we see, the same results.

The third experiment differs from the first in this, that to slake the lime, I plunged it into water for fifty seconds—afterwards treating it in the same manner as No. 1. The result was less by 22 lbs. It is singular that I got the same results, as will be seen further on, by making similar mortars and leaving them in the air, instead of placing them under water. The result, it seems to me, is owing to the lime, immersed for fifty seconds, absorbing too much water, which is hurtful, as the experiments in the following table will show. I purposed repeating the trial, by varying the time during which the lime should be immersed, but I had not an opportunity.

We have seen, in tables Nos. IV, V and VII, that the Obernai and Metz lime soon lose a great part of their properties, when they have been slaked to dry powder and left exposed for some time to the air. It is true that a piece of Obernai lime gave me, in this way, the most favourable result of table No. VI, but only in the first month after slaking: for, afterward, this lime rapidly lost its quality. We ought then, by no means to apply the process of Mr. Lafaye to hydraulic limes, unless assured of a different result from mine, which, I think, need not be looked for.

As to fat limes, table No XIV shows that when they were slaked to powder, and left in this state, in the air, for a couple of months, I obtained, by mixing this lime with trass, results sensibly better than when I used lime just slaked. I think, therefore, that it is best to slake fat limes to powder and to leave them for a month or two in this state in the air, before using them in mixture with hydraulic cements; but the process of Mr. Lafaye may be much simplified, by throwing on the lime a quarter, or a third, of its volume of water: it was in this way that I operated; avoiding, thereby, the embarrassment of panniers or baskets. We have seen, above, that lime slaked to powder has the property of absorbing oxygen; and it is to that property I attribute the benefit derived from leaving lime exposed to the air after being slaked to powder. Table No. XV offers a similar result; but as the proportions were not the same, I do not know which of the two modes is preferable—slaking fat lime to powder, or reducing it at once to paste.* We see that in both cases, there is an advantage in not making the mortars immediately. If time had been allowed me I should have repeated these experiments; making the proportions the same. It sometimes happens that hydraulic lime has been wet, either in the lime house from carelessness, or out of doors, when slaked and covered with sand. I accordingly made the following experiments with lime slaked with more than the usual quantity of water—making mortars therewith at different periods.

* Comparing the series of Nos. 1 and 3 of table No. XV, we see that at the end of six months, lime slaked to powder supported 44 lbs. more than that slaked to paste. but in the following mortars, the advantage was only 11 lbs. which is but trifling. Au.

Table No. XXVI.

Composition of the mortar.	Made immediately. H	Made immediately. W	After 12 hours. H	After 12 hours. W	After 24 hours. H	After 24 hours. W	After 36 hours. H	After 36 hours. W	After 48 hours. H	After 48 hours. W	After 60 hours. H	After 60 hours. W	After 72 hours. H	After 72 hours. W	After 84 hours. H	After 84 hours. W
	d.	lb.	d.	lb.	d	lb.	d.	lb.	d.	lb.	d.	lb.	d.	lb.	d.	lb.
Obernai lime slaked to humid powder with a volume of water equal to the volume of lime measured in powder . . 1 } 3; Sand . . 2 }	15	242	16	209	20	165	22	132	24	121	26	97	30	77	32	66

Observations on the experiments of Table No. XXVI.

To make the above experiments I took Obernai lime fresh from the kiln, and slaked it by throwing on a bulk of water equal to the bulk of lime: thus slaked, it was in the state of powder, but on pressing it between the fingers it was felt to be a little moist. I made at once, a mortar, taking one part of this lime in powder, and two parts of sand; and I put it in water, after having left it for twelve hours in the air: I made other mortars in the same way, every twelve hours, and at the end of a year, I broke them all. The table shows that after twelve hours the mortar had already lost much of its force, since the second mortar supported 33 lbs. less than the first. That which was made after twenty-four hours lost 77 lbs., and at the end of thirty-six hours, this lime gave a mortar that had lost almost half its force. The table shows that the strength of these mortars went on diminishing in a very rapid manner, to the last, which being made after eighty-four hours, supported only 66 lbs., in lieu of the 242 lbs. which the same lime sustained at first. We see also, that the rate of hardening decreased in a very rapid manner. These experiments show how dangerous it would be to slake hydraulic lime with too much water, and how important it is to keep it from the rain. In the experiments I have made, I almost always slaked hydraulic lime with one-fifth of its volume of water, and fat lime with one-fourth; because, as we have seen in the first table, the latter absorbs more water than hydraulic lime, before being reduced to paste. But in slaking on a large scale, the workmen always waste a portion of the water on the ground: there will therefore be no disadvantage in slaking hydraulic lime with one-fourth, and common lime with one-third of its bulk of water.

The experiments in the above table explain why mortar No. 3 of table No. XXV gave a result inferior to the others: the reason is, probably, because during the fifty seconds that the lime was plunged in water it absorbed too great a quantity; and as it remained twelve hours exposed to the air, it lost part of its strength. I will now give some experiments that I made in in order to ascertain the influence of different quantities of trass on the qualities of mortars.

Table No. XXVII.

No. of mortars.	Composition of the mortars.			No. of days required to harden in water.	Weight supported before breaking.
				days.	lbs.
1	Fat lime slaked to powder and measured in powder	1	$2\frac{1}{4}$	19	103
	Sand	1			
	Trass	$\frac{1}{4}$			
2	Lime the same	1	$2\frac{1}{2}$	15	163
	Sand	1			
	Trass	$\frac{1}{2}$			
3	Lime the same	1	$2\frac{3}{4}$	10	216
	Sand	1			
	Trass	$\frac{3}{4}$			
4	Lime the same	1	3	8	301
	Sand	1			
	Trass	1			

Observations on the experiments of Table No. XXVII.

We see that in the above experiments I first used a very small quantity of trass, and that I augmented it little by little. No. 2, containing very little trass, gave a result superior to many mortars made of natural or artificial hydraulic limes: such a mortar would not be dear, and might be employed with advantage in gross masonry.

I made no experiments to determine the quantity of sand or factitious puzzalona that would suit the hydraulic and fat lime, of the neighborhood of Strasburg, because I think these experiments should not be made on a small scale. We have seen that the same quarry furnishes limestone giving different results. A multitude of essays, on several pieces of lime calcined to different degrees, would have been necessary, which would have demanded much time. Instead of following this course, I proposed, (after getting some facts as to proportions from the above experiments) to take mortar already made at the works, the lime being there slaked in large quantities at a time: repeating this several times, I should have determined the quantity of sand and hydraulic cement which it would be proper to mix with the lime used at the works: but I quitted Strasburg before it was in my power to make these experiments. There was used at that place, as I have before stated, one part of quick lime (measured as quick lime) to two and a half of sand: the mortar was good; as there was occasion to ascertain in several partial demolitions.

Mr. Raucourt has advanced the opinion that sands require different quantities of lime according to their degree of coarseness; and to know the quantity of lime, it will suffice to measure the void spaces between the particles of sand, these void spaces being the measure of the lime. Accordingly, he filled a vessel, successively, with several kinds of sand and determined the quantity of water which could be poured on each without overflowing the vessel, whence he obtained for each the quantity of lime that should be added. But experiments should be made to ascertain whether the best mortar is obtained when these voids in the sand are just filled with lime; this Mr. Raucourt has not ascertained.

Before the publication of Mr. Raucourt's work, Captain Henry Soleirol of the Engineers, had engaged in researches of the same sort. Capt Solei-

rel, also, thinks that no more lime should be added than will fill these void spaces in the sand. But his experiments presented anomalies difficult to explain; and they are not sufficient tu cause us to admit the principle, in anticipation. This theory is ingenious, but it wants, as yet, the support of facts. The subject is important and deserves to occupy the leisure of Engineers.

The next table presents several experiments made with fat lime in reference to the manipulation of mortars.

Table No. XXVIII.

No. of the mortars.	Composition of the mortars.	No. of days required to harden in water.	Weight supported before breaking.
		days.	lbs.
1	Mortar in equal parts of fat lime, sand and trass, put in water immediately . .	18	290
2	Same mortar put in water after having been left twelve hours without being reworked .	13	328
3	Same mortar reworked, after twelve hours, without water—and put in water twelve hours afterward	13	330
4	Same mortar reworked, after twelve hours, with a little water, and put in water twelve hours afterward	15	326
5	Same mortar, put in water after twenty-four hours —without being reworked . .	12	308
6	Same mortar reworked after twenty-four hours with a little water, and put in water twelve hours afterward . . .	15	363
7	Same mortar, put in water after thirty-six hours without being reworked . .	12	319
8	Same mortar, reworked after thirty-six hours with a little water, and put in water twelve hours afterward . . .	15	363
9	Same mortar, put in water after forty-eight hours without being reworked . .	12	319
10	Same mortar, reworked with a little water, after forty-eight hours, and put in water twelve hours afterward . .	15	330
11	Same mortar put in water after sixty hours without being reworked . .	12	308
12	Mortar of one part of Obernai lime and two parts of sand, put in water immediately .	15	154
13	Same mortar put in water after twelve hours exposure without being reworked .	15	165
14	Same mortar, reworked with a little water after twelve hours, and put in water twelve hours afterward . . .	12	198
15	Mortar of Obernai lime, sand and trass in equal parts, put immediately in water .	4	405
16	Same mortar reworked with a little water after twelve hours, and put in water twelve hours afterward . . .	3	528

Observations on the experiments of Table No. XXVIII.

It often happens that a good deal of mortar is prepared and that bad weather for a day or two prevents the workmen from using it. If it be hy-

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draulic mortar, it becomes hard in the interval of a day, and often of a night, and it would be impossible to use it in that state. By reworking it for a long time, it might be brought to the proper consistence without any addition of water, but this is expensive: it is better to bring it to proper consistence by reworking it for a short time with a little water. Many Engineers think that mortar is improved by being worked several times a day: they consequently often make mortars several days before hand—work it well at first, and permitting it to stiffen, bring it again to proper condition by reworking, because, say they, *good mortars must be tempered with the sweat of the Labourer*: but the sweat of the Labourer costs money, which it is important to save. These considerations induced me to make the above experiments.

The first eleven mortars were composed of fat lime, sand and trass in equal portions. No. 1 was put in water immediately, while No. 2 was left twelve hours in the air, and then put in water without being reworked. This last we see gave a resistance sensibly greater than the first. Nos. 3, 4 and 5 remained twenty-four hours in the air before being put in water; No. 3 was reworked, twelve times, without water, No. 4 was reworked with water, and No. 5 was not reworked. It is important to remark that the results of No. 3 and 4 are very nearly the same as No. 2—No. 5 supported a weight sensibly less than No. 4.

After twenty four hours, it was not possible to rework these mortars without adding a little water. In consequence, Nos. 6 and 7 were put in water after thirty-six hours: with this difference between them, that No. 6 was reworked with a little water, while No. 7 was not reworked, No. 6, we see, gave a result decidedly better than No. 7.

Nos. 8, 9, 10 and 11, were made in the same way, and gave better results with those mortars that had been reworked with a little water, than with those that had not been reworked; at the end of sixty hours the resistance began to diminish.

If we compare Nos. 4 and 5, 6 and 7, 8 and 9, 10 and 11, which were left in the air, we shall see that those which were reworked with a little water, gave greater resistance than those which were not reworked.

If we compare Nos. 2 and 3, we see that this last mortar gained very little by being reworked, although it was worked over twelve different times. An excess of trituration, therefore, seems useless; for three or four pounds, more or less, of resistance, is almost nothing, when the mortars support 330 lbs.

Nos. 12, 13 and 14, were made with hydraulic lime and sand. The first two gave about an equal resistance; No. 14, which was reworked with a little water, was much the best of the three.

Lastly, Nos. 15 and 16, were composed of Obernai lime, sand and trass; No. 15 was put immediately in water. No. 16 was not put in until it had been worked with a little water. The latter gave a result much superior to the former.

I ought to mention that when the mortars had taken a slight consistence in the air, I always compressed them gently with the trowel before putting them in water; but Nos. 1 and 15 having been plunged into water as soon as made, were not compressed, while Nos. 4 and 16 were. I cannot think that so slight a compression has made so great a difference. We see besides that there is but little difference between Nos. 12 and 13, although this last had been compressed, while No. 14, which had been reworked with water, afforded a resistance much greater.

The mortars Nos. 12, 13 and 14, ought not to be compared with Nos.

15 and 16, first, because the last two contain trass, and, secondly, because the two limes were of different burnings. It results from the table, that when we have hydraulic mortar, composed of fat lime, sand and trass, or of hydraulic lime and sand, or mixed with trass; in either case, there is no disadvantage in reworking with a little water, when, from any circumstances, it has become too dry to be used. There is even an advantage in doing it; thus, in making mortar at night, and in the morning giving it a little water, and, by a little work, bringing it to its first condition, the mortar can only be improved thereby; but an excess of trituration is useless—not augmenting the strength of the mortar in comparison with the increase of expense. The following table contains several other experiments which I made on mortars.

Table No. XXIX.

No. of the mortars	Composition of the mortars.	No. of days required to harden in water.	Weights supported before breaking.
		Days.	lbs.
1	Mortar of one part of fat lime and two parts of trass	4	462
2	Same mortar with the same trass wet .	4	451
3	Same mortar with the same trass not so fine as No. 1	6	231
4	Mortar made of 1 part of Obernai lime and 2 parts of sand, put in the water at the end of 12 hours, without being reworked . . .	10	231
5	Same mortar, reworked after 12 hours, and put in water 12 hours afterward . . .	10	220
6	Mortar of 1 part of Obernai lime and 2 parts of sand tempered thin	10	176
7	Same mortar—tempered stiff . . .	10	161
8	Mortar of 1 part of fat lime half burnt and 2 parts of sand		
9	Mortar of 1 part of Obernai lime and 2 parts of sand	12	110
10	Same mortar with the sand broken fine .	10	253
11	Mortar of 1 part of Obernai lime and 2 parts of earthy sand	15	132
12	Same mortar, with the same sand after being washed	8	231

Observations on the experiments of Table No. XXIX.

The first experiment was made with ordinary trass which had been sifted through a fine hair seive; it was thus that I used it in all my experiments. No. 2 was made of the same trass which I had left during a month at the bottom of a vessel wherein it was covered with water. Several constructors think it necessary to keep trass from moisture; this experiment proves there is nothing to fear from water. There is no disadvantage in leaving the pieces of trass, or of burnt clay of which artificial trass is made, exposed. But, when in a state of powder, it is necessary to keep it covered from winds.

No. 3 was made of the same trass which had been passed through a much coarser seive. The result, as we see, was inferior, by one half, which is not surprising, as I shall show in the sequel. It appears that it is important that trass and hydraulic cements be finely pulverized: there should be no perceptible asperities on taking the substance between the fingers. The two experiments Nos. 4 and 5, have the same object as the preceding table; they were made from lime of another burning. No. 4 was put in water after twelve hours exposure in the air, without being reworked. No. 5 was reworked without water after twelve hours, and put in water twelve hours afterward. If there is any advantage, it is rather in favor of the mortar which

was not reworked; but such slight differences may be regarded as nothing. We can conclude only, that when hydraulic mortars have been well mixed, which is the case when they appear homogeneous to the eye, nothing will be gained by any further labour. But we have seen by the preceding experiments, that if, after having left mortars at rest for some time, they be worked up anew with a little added water, increased force will be given to them. Nos. 6 and 7 were made with the same Obernai lime. Both were left in the air for twelve hours before being put in water, and all other circumstances were the same. The only difference being, that No. 6 was made into thin, and No. 7 into stiff mortar. There is a sensible difference in the resistances: and that both are feeble, must be ascribed to their being both made of a piece of inferior lime. The result is in opposition to the opinion of Mr. Vicat, for at the conclusion of a note that he wrote on the first experiments that I published, he says: "Mr. Treussart affirms, as respects the manipulation, that mortars tempered to ordinary consistency, that is to say, soft, are better than stiff mortars. This implies a contradiction, not only of facts generally observed up to this time, but also, in a measure, of the observations of the author himself."

I announced these results in 1823, because they are important in the manipulation of mortars, and were furnished by my experiments. I am fully aware they are in opposition to the opinion generally received; but I do not see in what they are opposed to my own observations, nor does Mr. Vicat inform us. They, on the contrary, coincide with all that precedes.

We have seen, in fact, that mortars gain sensibly, after they have somewhat hardened, by reworking them with a little water. We have also seen, at the commencement of this memoir, that fat quick lime, reduced to thin paste with water, is capable, for a long time, of absorbing fresh quantities of water. Is it not probable then that it is the same with hydraulic lime? When it has been reduced in paste to the consistence of common mortar, it is possible that it may not yet have absorbed all the water necessary to convert it into the best mortar. It is possible that a mass of mortar put in water, may absorb but a small quantity in consequence of its prompt induration. If so, it is not astonishing that a new quantity of water added to a mortar, after it has absorbed the first—or that a mortar made more fluid at first, should give the best results. The question is important, because it is much easier to mix mortars when they are thin than when they are stiff; and there results, consequently, a considerable saving. I was bound to give the results obtained with Obernai lime, in order to draw attention to them, and engage constructors using those sorts of lime, to experiment on the subject. All the mortars made at Strasburg, whether for works in water or air, were made of the consistence of common mortars, and very often, when, from any cause, they had somewhat stiffened, they were worked up anew with a little water, and we always had very good results.

Experiment No. 8 was made to verify an important fact announced by Mr. Minard, Engineer of Roads and Bridges. He states that by burning the lime feebly, so as to leave a portion of the carbonic acid in the lime stone after burning, a very good hydraulic lime will be obtained. I, in consequence, repeated his experiment, taking a piece of fat lime stone and placing it in the kiln above the tiles, so as to burn it but partially. I satisfied myself, by testing with muriatic acid, that, after this feeble burning, the piece of lime still contained much carbonic acid: but it had also lost so great a portion, that on throwing water on it, it was reduced to powder. I made mortar with this lime—mixing it with sand, and put it in water;

but we see that I obtained no result: at the end of a year the mortar was entirely soft.

Experiment No. 9 was made with the same lime and sand as experiment No. 10; the only difference being that No. 9 was made with common sand in its natural state, and No. 10 with the same sand after it had been broken up very fine. Both mortars were composed of one part of lime in paste to two and a half parts of sand. Many constructors think that coarse sand is preferable for gross masonry. We see, however, that the resistance I obtained with common sand, not coarse, was only 110 lbs., while that given by mortar made of the same sand after it had been pulverized, was 253 lbs. I confess that this result surprised me greatly. When I made these two mortars, which were put in water, I made two others of the same kind which I left in the air. We shall see, in the second section, that the mortar made of common sand broke under a weight of 187 lbs., while that which was made of the pulverized sand supported 275 lbs., although it was cracked. Commonly, the mortars put in water have given me, when made of hydraulic lime, better results than those left in the air. I am induced, therefore, to think that No. 9 gave a result so feeble in consequence of some circumstance that escaped notice. It is possible that the mortar was cracked without my perceiving it; and it, therefore, as yet, appears to me doubtful whether there can be so great an advantage, as I find in these two experiments, in making mortar of fine sand; although it seems certain that there is an advantage in the case of hydraulic limes, in making mortar of fine sand. Mr. Vicat obtained a similar result, as we see by his table No. XVI.

No. 11 was made of one part of fat lime in paste to two parts of an unwashed, earthy sand used at Phalsburg. No. 12 was made of the same lime and the same sand cleared of the earthy matter by washing. The washed sand gave me a result almost double that afforded by the earthy sand. It is therefore very important to use clean sand.

We find in vol. VII, of the *Annales des Mines* a discussion between Mr. Vicat and Mr. Berthier, as to the cause of the solidification of mortars. Mr. Vicat attributed it to the chemical action exercised by the lime on the siliceous matter. Dr. John, on the contrary, had established in principle, that the substances mixed with lime to make mortars, and which he denominates alloys, *(alliages,)* are altogether passive. He relates that, according to his experiments, caustic lime attaches neither quartz, nor any other stony substance. Mr. Berthier, who has examined this question, says, "I think, with Mr. John, that the alloys perform no chemical part in mortars; these alloys appear to me to have the effect, 1st, of diminishing the consumption of lime; 2d, of regulating the shrinkage, by moderating it, making it uniform and preventing cracks; 3d, probably, of facilitating dessication and the regeneration of carbonate of lime, and hastening the induration; 4th, of augmenting the solidity of mortars." According to Mr. Berthier, the molecules of the alloy contract with the molecules of the lime an adherence more or less strong. If this adherence be less than that which unites the molecules of lime to each other, the mortar will not be more solid than was the pure hydrate: it will, however, cost less, it will harden quicker, and will be less subject to crack in drying, which is of itself a great advantage. But if the force of adhesion of the lime be less than the force with which it adheres to the alloy, we may conceive that the mortar may acquire more tenacity than the pure hydrate; and this is, probably, what takes place in mortars.

Other philosophers, and several engineers, have thought that the solidifi-

cation of mortars was owing to the lime passing again to the state of carbonate, by absorbing carbonic acid from the air. This opinion cannot, however, be sustained; for we know that carbonic acid penetrates only very slowly into the portion of hydrate of lime which is exposed to the air. Very large masses of mortar, plunged into water, will sometimes acquire complete hardness in three or four days, while other mortars containing the same quantity of lime, and placed in the same circumstances, often take more than a month to indurate. Mr. Darcet analysed the mortar from the Bastile, and found the lime had only half the carbonic acid required to saturate it. Mr. John analysed several ancient mortars that were very hard, and found a much smaller proportion of carbonic acid. Besides, it by no means follows that all the carbonic acid found in old mortars, has been absorbed by the lime: for we know from experience that it is difficult to disengage all the carbonic acid from lime by calcination. The lime we use in our constructions often contains a great deal; and it is not, therefore, surprising that the analyses of old mortars show a great difference in this respect. The following, moreover, is a proof that the absorption of carbonic acid has no influence on the induration of mortars, at least in the beginning. I took hydraulic lime and reduced it to the state of hydrate with distilled water, making a rather thick paste, which I placed at the bottom of a phial; I then filled the phial with distilled water and corked it tightly; and when the lime was so much stiffened as not to run, I inverted the bottle, (still corked,) placing the mouth in a vessel full of water. I repeated the experiment with mortar made of hydraulic lime and sand, and with another mortar of fat lime and trass. These three substances hardened as quickly as if they had been put in water which was in contact with the air. Being deprived of all communication with the air, we cannot ascribe the hardening to carbonic acid. The surface of several old mortars exposed to the air has been observed to have passed to the state of carbonate; but only for a small depth, and it requires several centuries to produce even this change. The induration of mortars cannot, therefore, be attributed to the regeneration of carbonate of lime.

The reasons given by Mr. Vicat, and Mr. Berthier, on the question whether there is, or is not, a combination of lime with the substances united with it to form mortars, not appearing to me to be conclusive, I shall offer my own opinion on this subject, so important as regards the theory—presenting some facts in support of my views.

To account for the solidification of mortars in water, it seems to be necessary to divide them into two distinct classes; those composed of hydraulic lime and sand, and those composed of fat lime and puzzalona, or some analagous substance. As to mortars made of hydraulic lime and sand, it is not at all necessary to suppose that there is a chemical combination between those two substances, for we have seen by the first tables that the hydraulic limes, alone, when they are reduced to paste, harden promptly in water without it being necessary to mix any substance with them. We might be led to believe that there was a combination between hydraulic lime and sand by experiments Nos. 9 and 10, of table No. XXIX, which prove that the strongest resistance is given by fine sand; but, on the other hand, the facts cited by Mr. John, who found that sand was not attached by quick lime, and the reasons given by Mr. Berthier, lead to the belief that there is no such combination. To explain the hardening of mortars made of hydraulic lime, it is not necessary to suppose that it combines with the sand, since this lime hardens when alone in the water. It remains then to ex-

plain why hydraulic lime, itself, should harden in water. I will observe, on this point, that this particular lime is a combination of lime and a certain quantity of argil, by means of calcination; it is a substance, therefore, altogether different from lime, and it has acquired new properties that the lime had not: lime dissolves in water, while good hydraulic lime does not.

We know that when we mix, in certain proportions, soda, or potash, which are opaque, and soluble in water, with silex, which is also opaque, and heat the mixture, we obtain a new substance, which is transparent and insoluble in water, and which is called glass. It is not, therefore, astonishing that lime mixed with a little clay and heated, should produce a new substance that will harden in water, while lime alone will remain soft. Although we give to this compound the name of hydraulic lime, it ought, in fact, to be regarded as a substance altogether different from lime; it is a new body with new properties.

As to hydraulic mortars made of fat lime and puzzalona, or other analagous substance, I do not see that the hardening in water can be explained without supposing a combination between the fat lime and the puzzalona; for this lime, put alone in water, or mixed with sand, remains always soft. To prove the truth of this explanation, I made the following experiment: I took a mortar composed of one part of lime made from white marble, and two parts of puzzalona, which mortar had been one year in water. From the centre of this mortar I took a piece which I reduced to very fine powder, putting the powder in a vessel which I then filled with distilled water. But we know that if fat lime be put in water, the water will dissolve $\frac{1}{400}$ of its weight in a few minutes. Nevertheless, after twenty-four hours, the distilled water had no portion of the lime. I satisfied myself, on the other hand, that the lime of the mortar had not passed to the state of carbonate: because, on throwing muriatic acid on the powdered mortar, there was very little effervescence. The lime had not therefore passed to the state of carbonate, and still it would not dissolve in water, which could only proceed from its state of combination with the puzzalona.

I communicated this fact nearly two years ago to Mr. Berthier, giving him a little of the pulverized mortar which I used in my experiment, and he obtained the same result that I did. I will add that I made some hydraulic mortar by mixing one part of fat lime measured in paste, with two parts of puzzalona; one portion of this mortar I placed at the bottom of a glass, and covered it immediately with water; the other portion was also placed in the bottom of a glass, but was not covered with water till after the lapse of twelve hours. A strong pellicle of carbonate of lime formed all over the surface of the water which had been put on the fresh made mortar, while in the case of the mortar that had been twelve hours in the air before being covered, there was only a light pellicle of carbonate of lime on portions of the surface of the water; more than half the surface of the water was without any pellicle. This experiment proves that lime combines very promptly with puzzalona.

The hardening of hydraulic mortars in water may be explained, then, in the following manner: if the mortar be made of hydraulic lime and sand, this last substance appears to be in a passive state; the induration of mortar takes place because hydraulic lime hardens of itself in water—this being a property resulting from the state of combination of a small quantity of clay with the lime. If the proportion of lime be too much forced, a good hydraulic lime will no longer be obtained. A similar effect occurs in making glass: if the quantity of soda or potash be too much forced, the re-

sult is nearly a deliquescent compound. When hydraulic lime is made of fat lime and puzzalona, the hardening takes place because there is brought about a combination of fat lime and puzzalona in the moist way. In this case—that the combination may work well, it is requisite that the puzzalona be in greater proportion than the lime.

There is always a reduction of volume, in making mortars, on the mingling of the constituents. I have endeavored to measure this diminution by experiments on a large scale. First, four heaps, composed each, of 10.60 cubic feet of Obernai quick lime, and 21.20 cubic feet of sand—making altogether 127.20 cubic feet, became reduced by manipulation to 101.71 cubic feet of mortar of ordinary consistence: the volume diminished therefore in the ratio of 1.00 to 0.80—that is to say, was lessened 0.20. In a second experiment, fifty eight heaps,* composed each of 10.602 cubic feet of quick lime, and 26.505 cubic feet of sand, forming together a volume of 2152.21 cubic feet, produced 1779.955 cubic feet of mortar. The primitive volume diminished, therefore, in the ratio of 1.00 to 0.822—that is to say, was lessened 0.178. According to the first experiment, the reduction was one fifth: and in the second, where there was more sand, it was about one sixth. These facts will be useful in making analyses, to determine prices.

Mr. Lacordaire, Engineer of Roads and Bridges, engaged on the canal of Bourgogne, has announced that he has obtained good hydraulic mortars by the following means. He burnt hydraulic lime stone but partially, and slaked it by immersion. The portions the most burned fell to powder; and the lime thus furnished he used by mixing it with sand, and with the portion of the lime stone that did not slake; which portion he pulverized and used as a cement. There has been established, at Pouilly, a manufactory of this substance, to which the name of Pouilly cement has been given; and as a cement, it is mixed with fat lime. We see that Mr. Lacordaire has applied to hydraulic lime, a process analagous to that which Mr. Minard proposed for fat lime stone, and which in our trials gave no results, as may be seen page 80.

I procured two specimens of the hydraulic lime stone of Pouilly, and also a piece of the half burnt lime of which the cement of that name is made. One of these lime stones is a distinct blue, and the other of an ash colour. The piece of half burnt lime was of a brown colour, and had been out of the kiln about six months. I made with this half burnt lime the following essays: I detached a piece on which I poured water; there was no heat given out, and it did not fall to powder. I then put a piece in muriatic acid diluted with a little water; there was considerable disengagement of carbonic acid, and it dissolved, leaving a residue of about one fifth, which was clay mixed with a little red oxide of iron. I reduced the piece still left, to a very fine powder, and made therewith the following experiments: I first mixed one part of fat lime measured in paste, with two parts of this powder. After having well mixed the whole with a little water, to bring it to the consistence of sirup, I placed it in the bottom of a glass. One hour afterward I was obliged to cover it with water, because it became consistent. Twelve hours after being covered with water, it was completely hard. I made a second experiment by reducing the powder, alone, to paste with water, and in an hour after being placed in the bottom of a glass, it was covered with water; at the end of twelve hours the induration of this, also,

*In the original, it is 52 heaps, which must be a misprint, as it requires 58 heaps to make up the quantity of 2152.21 cubic feet.—*Trans.*

was complete. Lastly, I made a third experiment with one part of fat lime and two parts of this powder, as in the first essay; but I added no more water than was requisite to reduce the mixture to a thick paste, and I left it in the air; it hardened with as much promptitude as plaster of Paris: and fifteen days afterwards it appeared to possess very great hardness. It will be possible, perhaps, to substitute this substance for plaster advantageously.

It results from the essays just given, that this matter reduced to paste with a little water, hardens in water, and in the air, with great promptitude; and that, employed in powder with fat lime, in the manner of puzzalonas, an equally prompt hardening is obtained. It appears to me that the name *cement* given to this substance is not suitable; for it is, really, a subcarbonate of hydraulic lime, that is to say, an hydraulic lime but little burnt, and containing, consequently, much carbonic acid. I may here observe that if we mix one part of fat lime with two parts of good hydraulic lime reduced to powder, this mixture will, equally, harden in water, without our being authorized to say that this powdered hydraulic lime is *cement*. This name belongs only to the powder of burnt clays; it is possible, however, that usage will preserve to this substance the name of cement, since it is used in the same manner as cement.

The fine observation of Mr. Lacordaire opens a new field as to hydraulic mortars. It will be very important to ascertain the tenacity of this substance; for we have seen by the Boulogne pebbles, and by several other mortars, that those which harden very quickly do not offer a great resistance. We have seen by table No. III, that several hydraulic limes, well burned and reduced to paste with water, have given, alone, greater resistance than when mixed with sand. The great promptitude of induration of these slightly burned limes merits particular attention. To judge accurately of this new mode of employing hydraulic limes, it will be necessary to make comparative experiments, first of the same lime stones, both slightly burned and thoroughly burned, made into paste with water; afterward by mixing them with a great quantity of sand; lastly, the lime but slightly burned should be used as cement with fat lime and with hydraulic lime, and with each of these kinds of lime united to sand. The hardening of the several mixtures should be compared; and at the end of a year they should be submitted to rupture, to determine their tenacity. Supposing that one part of fat lime, mixed with two parts of lightly burned hydraulic lime used as cement, should give a resistance equal to that afforded by mortar composed of the same hydraulic lime well burned and two parts of sand, it will then be necessary to examine which of these two processes is the cheapest.

In the first case lime only, which is a dear substance, is used; but the hydraulic lime, which composes two-thirds of the mortar, being much less burned, requires less fuel, at the same time that it requires a good deal of labour to pulverize it. We see, then, that it is by comparing the expense, with the resistance, of mortars, that we can fix upon the process to be adopted. There are circumstances, undoubtedly, where it is important to secure a speedy induration; but in ordinary cases, there is no inconvenience in waiting eight or ten days to allow the concrete, or mortar, to take sufficient hardness. It is to be presumed that we shall, ere long, have experiments which will show us whether this new mode of employing hydraulic lime presents advantageous results, as respects the tenacity of mortars. In those places where good hydraulic lime is found, it is very important that the experiments, of which I have spoken, should be made.

I have said that the half burned lime which I used as cement, had been

calcined for six months; and that I obtained, nevertheless a prompt induration. That might be owing to its being still a stone, and that the air could not penetrate to the interior. It will be important to ascertain whether this lime will preserve its energy thus long, when reduced to powder. It will be equally necessary to know if it be indifferent whether this lime be plunged in water as soon as it is burned; or if it be preferable to half burn the whole kiln, so that it shall receive no water until it comes to be mixed into mortar with thorough burned lime.

We find in the VII volume of the *Journal des Mines*, the analysis, made by Dr. John, of several old mortars; and by Mr. Berthier of several lime stones. I will terminate his article by the exposition of these analyses in the following tables.

Analysis by Dr. John of several Mortars.

	Mortars in air.						Hydraulic mortars.		
	1	2	3	4	5	6	7	8	9
Carbonic acid	0.0600	0.0575	0.0175	0.0500	0.0900	0.1200	0.0050	0.0225	0.0225
Lime in the state of carbonate	0.0800	0.0781	0.0260	0.0663	0.1194	0.1591	0.0070	0.0295	0.0298
Lime combined with other substances	0.0170	0.0431	0.0665	0.0207	0.0322	0.0809	0.0305	0.0395	0.2977
Combined silex	0.0100	0.0115	0.0375	0.0125	0.0025	0.0025	0.0200	0.0035	0.0800
Quartz and sand	0.8000	0.8010	0.7850	0.8375	0.6884	0.5600	0.7750	0.8950	0.3500
Alumine—oxide of iron					0.0275	0.0275			
Water . .	0.0330	0.0088	0.0675	0.0130	0.0400	0.0500	0.1625	0.0100	0.2400
	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

1. Mortar one hundred years old, from the exterior joints of St. Peter's, at Berlin.

2. Mortar a hundred years old from the interior joints of the same church.

3. Mortars six hundred years old, from a covered (*encombrée*) foundation of the same church.

4. Mortar six hundred years old, from the walls of the Cathedral of Brandeburg.

5. Roman mortar, from the wall of a tower built at Cologne under Agrippa in the first century of the Christian era.

6. Roman mortar from a tower built by Agrippa.

It appears that in these last two mortars the portion of lime not saturated with carbonic acid is combined with the alumine.

7. Mortar three hundred years old, from the outside wall of the old castle of Berlin.

8. Old Roman, hydraulic mortar.

9. Mortar from Treves four years old.

We see by the above table that none of these mortars contain, by a notable quantity, the portion of carbonic acid required to saturate the lime; since according to the analysis of page 230, vol. xx, lime-stone contains, ordinarily, 33 per cent of carbonic acid. Mortar No. 5, for example, which was nearly two thousand years old, contained only about 13 per cent; and it is to be noticed, as I have already said, that the lime, as we use it in our constructions, is never completely deprived of this acid. We notice also that

the hydraulic mortars are those which contain the least carbonate of lime. And lastly that a part of the lime is found united chemically with other substances, such as silex alumine, and iron, and perhaps with all three at the same time. These substances appear to be combined with the lime by calcination.

Lime produced by different calcined limestones, yielding common lime according to the analysis of Mr. Berthier.

	Fat Lime.						Meagre Lime.	
	1	2	3	4	5	6	7	8
Lime	0.964	0.954	0.972	0.935	0.916	0.860	0.780	0.600
Magnesia	0.018	0.018	0.000	0.010	0.015	0.090	0.200	0.262
Clay	0.018	0.028	0.028	0.040	0.069	0.050	0.020	0.000
Oxide of iron &c.				0.015				0.138
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

1. Limestone of the fresh water formation of Chateau—Landon near Nemours; compact, yellowish, a little cellular, sonorous: yields very fat lime.

2. Limestone of Saint-Jaques; compact, yellow, texture somewhat saccharoidal; it forms the base of the Jura mountains; makes a very greasy lime which hardens but slowly.

3. Lower marine limestone (*calcaire grossier*) of Paris: gives very greasy lime.

4. Limestone which forms the roof of the iron mine of La Voulte (Ardiche;) compact, yellowish white: containing shells which prove it to be contemporaneous with the Jura limestone, specific gravity 2.67: gives very good fat lime.

5. Limestone of Lagneux (Ain:) compact, of a light yellowish gray; affording fat lime which is much used at Lyons.

6. Fresh water limestone of Vichey (Allier:) compact, cellular, yellowish white, gives very good lime, but not very greasy.

7. Limestone of the neighbourhood of Paris, which appears to belong to the fresh water formation: compact, yellowish; gives meagre lime, but not hydraulic.

8. Secondary limestone of Villefranche (Aveyron:) lameller, of an ochery colour, the lime obtained in an experiment on a small scale was very meagre without being hydraulic.

Limes produced by different limestones, yielding hydraulic lime according to the analysis of Mr. Berthier.

	Moderately Hydraulic.					Very Hydraulic.					
	1	2	3	4	5	6	7	8	9	10	11
Lime	0.870	0.830	0.840	0.820	0.820	0.745	0.688	0.740	0.683	0.700	0.746
Magnesia	0.040		0.025	0.015	0.015	0.035	0.060	0.020	0.020	0.010	0.160
Clay	0.090	0.070	0.135	0.165	0.165	0.220	0.252	0.170	0.240	0.290	0.078
Oxide of iron' &c.		0.100						0.070	0.057		0.016
	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

1. Limestone of Vougny (Loire;) sub lamellar, yellowish, filled with ammonites and other shells; yields very good lime which sets in water.

2. Limestone of Saint-Germain (Ain;) compact, deep gray, veined with white carbonate of lime; lamellar, and penetrated with gryphites, &c., at Lyons this lime is used for hydraulic works.

3. Limestone of Chaunay near Macon; compact, fine grained, yellowish white, it is of the secondary formation: this lime is hydraulic.

4. Limestone of Digne (Jura;) compact, penetrated with plates of calc-spar (*lamelleo de calcaire*) and containing a great number of gryphites, of a deep gray, this lime is hydraulic.

4. Limestone which accompanies the preceding, and which possesses the same properties; compact, of a grain almost earthy; of a clear gray.

6. Secondary limestone of Nimes (Gard;) compact, yellowish gray; affords a hydraulic lime which is there considered of excellent quality.

7. Lezoux lime (Puy-de-Dome;) made of a fresh water calcareous marle; it is said to be excellent, they are in the habit of slaking it by leaving it in heaps in the air, after having moistened it: it produces a copious jelly with acids.

8. Compact limestone of an unknown locality: gives very good hydraulic lime.

9. Secondary limestone of Metz (Moselle;) compact, of a grain almost earthy, of a bluish gray more or less deep: the lime it affords is known to be very hydraulic.

10. Calcareous marle of Senonches, near Dreux (Eure-et-Loir;) compact very tender, may be diffused through water like clay, but does not fall to powder when burnt. This substance is not like the limestones which have an earthy fracture, a mixture of carbonate of lime and clay. It leaves in acids a mealy residue, soft to the touch, which contains only a trace of alumine, which dissolves in liquid caustic potash even when cold, and which comports itself in all respects like silex which has been separated from combination: nevertheless it is certain that this substance exists in the Senonches lime only in the state of mixture: because, by operating with great care, we find by analysis, that the proportion of carbonic acid is exactly that which is necessary to saturate the lime. I have, before, in some varieties of carbonate of magnesia (*magnésie carbonatée*,) encountered silex soluble in alkalis, although not in combination, but have never found it in carbonate of lime. The Senonches lime is very well known: it is much used at Paris: it hardens more promptly, and acquires greater hardness than Metz lime: it dissolves in acids without leaving the least residue. (What Mr. Berthier says here of this lime is very remarkable and deserves to fix attention on this particular kind of lime.)

11. A mixture of four parts of chalk from Meudon and one part of Passy clay (in volume,) which Mr. Saint-Leger uses to make the artificial hydraulic lime of Paris.

If we compare the common limes of the first table, above, with the hydraulic limes of the second, we shall see, 1st. that the latter contains, in general, much more clay than the former: 2d., that several limes contain more than two-tenths of magnesia, without being hydraulic, while they become eminently so, when they contain the same quantity of clay: 3d., that almost all the common limes contain a small portion of clay. We see that No. 5 of the common limes contains, within one thousandth as much clay as No. 2, of limes moderately hydraulic: it is probable that these two limes have about the same degree of hydraulic property, but that it is weak. It

would be interesting to know the resistance of the mortars made of all the limes contained in the above two tables. It is only by determining the tenacity of mortars made of limes of which the composition is well known that we can adjust the composition and proportion of clay so as to produce the best hydraulic limes.

Article viii.—*Of Sand, and Hydraulic Sand* (*Arénes.*)

Sands are classed relatively to their constituent parts: thus there are siliceous sands, granitic, calcareous sands, &c., some sands result from the slow decomposition of rocks of the same nature. Sometimes they are mixed; and it often happens that they contain several metallic substances—principally iron.

The different revolutions that the earth has undergone have caused considerable deposits of sand in places where there are now no water courses; and even at great elevations. On certain coasts there are extensive collections of sand, which the French calls *dunes;* these are heaped up by the winds. Rivers transport a great deal of sand, and their shores are some times covered with it. Sands are often mixed with vegetable earth. In this case they are not proper for mortar. To be suitable to this end, they should be almost perfectly free from earthy matter. When on the subject of mortars exposed in the air, I shall point out a very simple means, that I have used for several years, of freeing sands from the earth they contain.

Constructors distinguish sands into *river sand*, *sea sand* and *pit sand.* This last is found in the great deposits mentioned above: it bears the name of *fossil sand*, also: its grain is generally more angular than that of *sea sand* or *river sand.* All these sands contain the same elements. Siliceous, or granitic sand, or a mixture of the two, are most common: calcareous sands are most rare.

Vitruvius, and others after him, thought that *fossil* or *pit* sand was the best for making mortar. Belidor thought, on the contrary, that *river sand* was preferable. Mr. Rondelet has since made experiments which appear to establish that *pit sand* is better than *river sand.*

I purposed examining whether, in fact, there was much difference, in making mortars of one sand rather than of another: but I quitted Strasburg before I could apply myself to the subject. Nevertheless, some facts, of which I shall speak when on the subject of mortars exposed to the air, lead me to believe that the divergence of opinions, as to which are the best sands, results from the experiments having been made with sand more or less fine, or more or less earthy. The experiments cited page 81, show that earth mixed with sand is very injurious to mortars. But the authors quoted above do not say whether, before making these experiments with pit and river sand, they took care to wash both of them. If they did not wash them, the superiority which they found to belong to either, may have been, on one hand, due to the greater freedom from earthy matters of the better sand of the two, and on the other, to the greater fineness of the particles. My results were obtained with granite sand, and it remains to be ascertained whether they would have been the same with other kinds of sand. The question is important, and should be examined with care.

A species of fossil sand has lately been discovered, which is very remarkable: the knowledge of this singular substance is due to Mr. Girard de Caudemberg, Engineer of Roads and Bridges. This Engineer published,

in 1827, a very interesting notice of this subject, which cannot fail to produce important results. I will state succinctly the principal facts contained in this notice, and I will add some observations that have been made since.

"There exists" says Mr. Girard," in the valley of the river Isle, fossil sands of which the colour varies from redish brown to yellowish red and even ochre yellow. They are called '*arénes*,* which denomination we shall preserve in this notice, to distinguish them from common sands. These sands are often used alone, as mortar, in walls of enclosures and of houses; and as they have the property of making a paste with water, and as they shrink less than clay, they are very proper for this kind of construction: they represent in this case a *pisé*, which acquires hardness and resists inclemencies. But the proprietors of the mills on the river Isle, in the department Gironde, discovered by accident a quality in the *arenes* much more important and worthy of serious attention; they use it with common lime more or less fat, to form mortars which set under water and acquire great hardness."

Mr. Girard says that for want of hydraulic lime, he made several Locks with mortar composed of common lime and *arenes*. He states that he obtained very good results; and that the following year it was necessary to use the pick to break up the concrete that had been made with these *arenes*.

The examination of the *arenes* showed Mr. Girard that they were all composed of sand and clay in various proportions. By means of washing and decantation he separated the clay from the sand, and in eight kinds of arenes he found the proportions of clay varied from ten to seventy per cent. He ascertained that those arenes which were meagre, were hydraulic only in a very feeble degree. The sand of the arenes is sometimes coarse and sometimes fine: it is occasionally calcareous, but more frequently siliceous or mixed. Some of the arenes are red, others brown, yellow and sometimes white.

The arenes are generally found on the summit of the hillocks which form the basins of rivers and brooks: they are rarely found in valleys. The deposits of the substance are superimposed on masses of argillaceous tufa (*tuf argileux*,) or calcareous rocks; they have all the characters of an alluvial deposit. The beds are often separated by pebbles. Rolled pebbles are, moreover, often seen disseminated here and there in the mass. Some of the beds are more than fifty feet thick. Mr. Girard says it appears to him that the environs of Bordeaux, and the valleys of the Aube and upper Seine, contain a great deal of it; and that it exists in a multitude of localities.

Mr. Girard had occasion to ascertain that the arenes were employed in many ancient constructions, and he cites, among others, the thick revetments of a remnant of fortification at Mucidan (Dordogne) which dates back several centuries, and it appears that the very old constructions at Nimes were made with arenes.

Mr. Girard says he has assured himself by experiments that in preserving for a year under water, mortars containing equal proportions of crude energetic arenes, and the same arenes calcined, that there was no appreciable difference in their consistence; but that the torrefaction of the arenes

* It appears that the word *arène* was known to several Constructors, for Mr. Sganzin says page 25, in speaking of Sands: "They call *arènes* those of which the particles are finer and more regular." And this is all he says. Au.

had the advantage of hastening in a remarkable manner, the setting or induration of the concrete.

Mr. Avril and Payen discovered, about the same time, in Bretagne, the properties of puzzalona, in gray wacke, and in decomposed granite, though to a degree quite feeble. They remarked, besides, that natural puzzalonas acquire a new degree of energy by a slight calcination.

Captain Leblanc of the Engineers, employed at Peronne, gave on the 30th November 1827, an interesting memoir on the arenes which are found in great quantity in the neighbourhood of that place. I will transcribe the commencement of the memoir. "In the numerous demolitions, made in 1825 and more especially in 1826, preparatory to the repair of the crown work of Paris, it was remarked that the ancient mortars (from 150 to 600 years old) were generally very hard. It was particularly noticed, at the time of the demolition of the piers of bridge forty-one, which was situated in quick sand, below the level of the waters, that the mortar was harder than elsewhere. To these facts the only exception was in the demolition of scarp thirty-three at the close of the year 1826. The mortar of this masonry was still soft. On examining the mortars which were hard, it was perceived that the sand therein was very fine, and that these mortars, from their aspect, seemed to have been made of the sand of the country, rejected in the official instructions, because too earthy. (This sand is used in all the constructions of the town.) Another consideration led to the belief that the sand of the country had been used: for all this masonry appeared to be very carelessly put together; the mortar, badly made, showed every where, lumps as large as a hazle nut, of lime not mixed with sand and still soft; although all the surrounding mortar was very hard. It was to be presumed that when applying so little care to all parts of the workmanship, the constructors had taken no greater, as to the choice of sand: and that they used that which was nearest at hand—namely the sand of the country. We have said that the mortar of scarp thirty-three was found still soft after two hundred years: it seemed on examination to be meagre; and, although the sand seemed to be the sand of the country, the mortar did not look like the other; under these circumstances, this example suspended, for the time, the conclusions that had already been drawn as to the advantage of using the Peronne sands."

The author states that on recommencing labours in 1827, he made six cubes of mortar, of which three were composed of sand recommended in official instructions, and the other three of the clayey sand whereof the good masonry appeared to have been made. One cube of each kind of mortar was left in the air, one put in a humid place, and one in water.

It was in this interval, as Capt. LeBlanc states, that the notice of Mr. Girard appeared. What was said in that notice showed that the clayey sand of the neighbourhood of Peronne was a true arene. The mortar made of common lime and this arene had completely hardened in the water at the expiration of a month; so as to receive no impression when borne upon strongly by the thumb. A mortar made at the same time of the same lime and of the sand recommended officially, and usually employed, remained entirely soft at the end of several months. By heating the arenes, Capt. LeBlanc ascertained that the hardening took place much more promptly, for the mortars made of the crude arenes required a month to harden, whereas those made of arenes that had been heated, hardened in eight or ten days. This officer undertook some experiments to determine the degree of calcination proper to impart the quality of most prompt hardening,

and to ascertain whether the effect of calcination would be to augment in a sensible manner, the strength of mortars, but his experiments are not yet finished. The discovery of arenes in the environs of Peronne, is, at all events, a great advantage for the works in progress at that place. Masonry in the air may be executed with crude arenes; and if it appear that calcination augments both the promptitude of hardening and the solidity of mortars, this operation might be resorted to in all cases of constructions in water.

The arenes of the environs of Peronne are found on the tops of the hillocks which border the valley of the Somme, like those of the valley of the Isle, and they lie upon a calcareous mass. Towards the bottom of the river banks, the arenes are mixed with fine sand, and moderately fine sand, and sometimes, with coarse grains. It is only towards the tops of the hillocks that they are found composed entirely of fine sand. The inhabitants call it clay. It is found, also, on hills quite elevated. Capt. LeBlanc states that the arenes which contain only very fine sand are less hydraulic than those which lie a little lower and which contain a mixture of fine and moderately fine sand; that in those places where the ground rises gently from the river, the banks of sand are always mixed with, and sometimes separated by rolled or broken pebbles, which is another point of resemblance with the arenes of the valley of the Isle, as described by Mr. Girard. The colour of these arenes is obscurely reddish, a good deal resembling bistre: they present the appearance of an ochrey earth.

Capt. LeBlanc adds that since the discovery of the arenes of Peronne, they have been found at Bapaume, at Douai, on the road from Bethune to Arras, and that this substance appears to be very common in the valley of the Somme, and in Flanders. At Bapaume, the workmen have known for a long time that this clay was hydraulic: the millers of the neighbourhood having executed works in the water therewith, with very good results. In the month of July last, Captain LeBlanc informed me that there had been found in the neighborhood of Ham, an arene pronounced to be more hydraulic than that of Peronne, and that it was used a long time ago in the fortifications of the castle.

I procured some of the arenes from Ham: they sent me two kinds; one yellow and the other greenish. We shall see in the sequel that they are clays. I satisfied myself that they contained no lime. I made two kinds of mortar therewith, taking one part of lime in paste to two parts of the arenes, and put them under water. I made a similar mortar with puzzalona. The puzzalona mortar hardened completely in six days: the two mortars made of arenes had not fully hardened at the end of three months. These experiments were made last December, which retarded the induration no doubt; but being placed in a chamber where the temperature was about ten degrees, (cent.) (50 Far.,) I was astonished at the slowness of the induration.

I calcined some of the greenish arene, keeping part at a low red heat for half an hour in a crucible; another part during one hour; and a third portion during two hours. I then made three mortars like the above, with these three calcined arenes. The two mortars of the arenes, calcined, one for half an hour, and the other for an hour, hardened in a month. That calcined for two hours, required nearly two months to attain the same degree of hardness. It is true that I did not calcine this substance in a current of air; but I was surprised that, being calcined, it did not harden sooner. It will be important to make many experiments on different arenes, crude,

and calcined in various degrees, so as to know the greatest promptitude of induration that can be secured, and the tenacity of mortars both in air and water.

Two specimens of mortar taken from the Castle of Ham were sent to me: one of these mortars was made in 1601, and the other in 1802; they were both of very strong consistence. I found, nevertheless, that they did not offer the same degree of hardness as mortars made of trass and hydraulic cement; but these arenes will be not the less advantageous in constructions in water and in air, on account of the great economy that attends their use. In places where good arenes are at hand, they should, in cases where a prompt hardening is required, in caps of arches, &c., always be employed mixed with hydraulic cement.

I had occasion to notice, a short time since, between the park of Versailles and Saint Cyr, a hillock of clayey sand which looked to me like the sand from Ham: some was yellow and some red; the colours being well separated. I made with these two clayey sands, two mortars composed of one part of fat lime and two parts of these sands, and placed them in water. They were not indurated at the end of four months, but it was perceptible to the touch, that they had taken a degree of consistency.

At Paris they build the walls of houses with plaster, and cellar walls with mortar. I have had occasion to observe latterly, that several of these mortars were made of clayey sand which appeared to me to be a species of arene: it contained a little lime, and some of it is yellow, and some greenish, like that from Ham. I learned that this sand was brought from the neighborhood of the ancient garden of Tivoli, and that it appears to have been employed at Paris for a long time to improve mortars. I made two mortars of these two clayey sands, adopting the same proportions as with the sands from Saint Cyr, and placed them in water. The results were similar to those given by the clayey sands from Saint Cyr. From what has been said, we see that these clayey sands are arenes of little energy: they do not appear to me to be proper for mortars that are to be placed in water; but the hydraulic property they possess, feeble as it is, will give, for works in the air, much better mortar than ordinary sand. From what has been stated above, it appears probable that there exist several banks of arenes in the neighborhood of the Capital; and it is probable some may be found more energetic than those I tried; it will therefore be important to make researches, adopting the same process as is recommended page 31, for cements.

If we mix clay with fat lime, the resulting mortar will take no consistence when put under water. It is necessary that clays be more or less calcined to become hydraulic. Mr. Girard seems to think that the arenes have been submitted to the action of fire, and that perhaps they have a volcanic origin; but this second assertion does not seem to be a necessary consequence of the first; all that we may affirm is, that the arenes are clays which have sustained the action of fire. On the other hand, the small rounded stones and pebbles found in some of these deposits, prove that they are, also, alluvial. It is not easy to meet important facts without seeking to account for them, although at the risk of deceiving ourselves.

The flattening of the poles of the earth, and the swelling out of the equator, demonstrate that our globe has been in a soft state. Some philosophers maintain that the earth was in a state, primitively, of fusion; these are called *Vulcanists*. Others contend that the softness of the earth was an effect of water; these are called *Neptunists*. The opinion of the *Vul-*

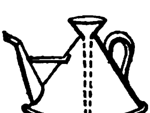
canists is a very ancient one, and prevailed for a long time; but the great number of shells, the remains of marine animals, and other objects, encountered at very elevated positions, superseded the opinion of the *Vulcanists* with that of the *Neptunists.* Later still, new observations, and amongst others, the great heat of certain thermal waters; the elevated temperature which is found at the bottom of very deep mines; the sudden formation of some islands which have been thrown up from the bottom of the sea, and several other facts, have brought back the old opinion that our globe was primitively in a state of incandescence; and there are, at this day, several philosophers who think that the earth is cooled only at the surface, that it is still in a state of incandescence in the interior, and that volcanoes communicate with this vast focus of heat. But whatever may be the opinion adopted as to the primitive condition of our globe, it cannot be doubted that it has sustained several successive modifications by fire and water. The hypothesis that the globe was at first in a state of incandescence, and that it has since sustained revolutions by the operations of water, is that which appears to me to accord best with various observed facts. The presence of arenes over a considerable extent of France, in places where no traces of extinct volcanoes are to be found, is an important circumstance for geologists. It is curious to see the study of hydraulic mortars furnish new arguments in favor of the theory of the *Vulcanists:* but, as often noticed, all the sciences have some points of contact.

The experiments that I shall give in the second section, on mortars made of fat lime and sand, and exposed to the air, will show how important it is to search after good arenes in the environs of our public works; because it is a means of procuring good mortars at a very cheap rate, and because it is the only means of procuring them cheaply, in countries where there are no hydraulic limes.

(TO BE CONTINUED.)

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Improvement in oil cans, or feeders. By A. C. Jones, Engineer.



In oiling machinery, especially Locomotive engines, great loss of oil arises from the can being upset or by falling. The improvement, shown in the margin, can be applied to the common can, by soldering a tube to its top which extends internally to within a short distance of the centre of the bottom. A small vent hole is made at the top of the can, to allow the air to escape when filling: it is obvious that the can may be turned bottom upwards, or on its side with a very small loss of oil compared with the old plan.

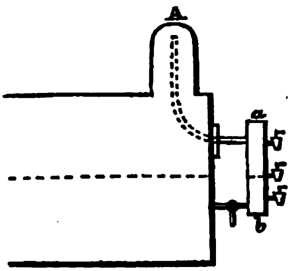
FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Water Gauge for high pressure Steam Boilers. By A. C. Jones, Engineer.

The object of this improvement is to find the correct height of the water in a boiler when it *foams.*

The apparatus consists of a tube or chamber *a, b* of the same metal as the boiler about 14 inches long and 2¼ inches in the clear. Near the top and bottom a small pipe, or tube, of one-half inch bore is inserted to connect it with the boiler, the top branch being continued by a pipe within the boiler to the highest accessible point; the lower branch is connected below the lowest point at which the water can be worked, and has a cock

for the purpose of shutting off the communication with the boiler. Three gauge cocks are inserted in the front of the vertical chamber, *a*, *b*, at the same height as is customary on the old plan of operation. If the cock in the lower branch pipe is left open, the gauge cocks act in the same manner as if in the head of the boiler. If the boiler foams, the lower communication is cut off by the cock, the upper gauge cock is then opened, and if there is any water above it, the pressure of the steam on its surface forces it out to the level of the cock and no farther, and the length of time it takes to discharge the water, with a little practice gives the height of the water line above the cock; if no water is discharged from the upper cock it is shut, and a trial is made of the others, in succession.



The operation may be repeated by opening the communication with the boiler and allowing the water to rise to its level in the chamber.

I have tested this plan since its first invention (about three years since,) on locomotive, stationary, and steam-boat boilers; with decided success.

Bibliographical Notice.

The final report of the committee of the Philadelphia Medical Society, on the construction of instruments, and their mode of action, in the radical cure of Hernia, &c. By Heber Chase, M. D. Philadelphia, J. G. Auner, p. 243.

There are but few articles which are more frequently presented at the Patent Office as new and useful improvements, than Trusses for the cure of Hernia. A large number of these are but pretended improvements, presented by persons ignorant of what has been heretofore done upon this subject, or anxious only to obtain that species of sanction which the seal of the office is supposed to afford. The work, the title of which is given above, affords much information respecting the construction of such trusses as have been previously used, as well as of those which have been made the subject of a Patent by Dr. Chase; and as we have been supplied with the engravings used in the above work, we have deemed the subject suitable to our pages. One thing is certain, there is not any other point appertaining to our Medical or Surgical practice, in which so large a portion of our readers would be personally interested. Dr. Chase has obtained Letters Patent of the United States, for his trusses, under their various modifications, the nature of which are distinctly pointed out in the following review.

Those of our readers who are engaged in the practice of medicine, may recollect, that in consequence of the great importance of the subject, the Philadelphia Medical Society appointed a committee of Surgeons in the year 1834, with unlimited instructions to investigate the subject of hernia, together with the means employed for treating this disease. This laudable step was undertaken no doubt, in consequence of the numerous trusses of ephemeral existence which are yearly palmed upon the ignorant and unsuspecting, by impostors alleging their capability of curing hernia in all its forms;—a degree of pretension carrying with it the proof of its own fallacy. This committee made its preliminary report on the 5th and 12th of Decem-

ber, 1835, and the final report was read before the Society, and adopted on the 29th of April, 1837. The first of these reports was published in the American Journal of the Medical Sciences for February, 1836. The second, in the No. for August, 1837.

The speculative and theoretical views of the predecessors of the patentee, and of many of the profession, tending to show that a cure in hernia depended upon irritation produced by the instrument, and followed by "adhesive inflammation," was believed to be incorrect.

Doctor Chase, we think justly describes hernia, to be in a majority of cases, a dilation or enlargement of the natural aperture of the body, produced by a variety of causes. Proceeding upon this ground, his aim has been to construct his instruments upon Surgical and Anatomical principles; each instrument being adapted to one appropriate form of the disease only.

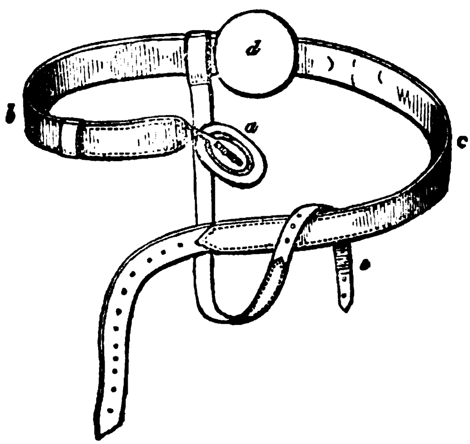
The instruments of Doctor Chase are five in number viz: The Inguinal —Ventro Inguinal—Femoral—Umbilical—and Double Trusses.

The report above referred to, contains 46 pages, 8mo. and is a model for this kind of essay: it is clear, unpretending, and profound, and is evidently the production of a meditative and reflective mind.

We will now give an epitome of the construction of the instruments, mode of application, and method of treatment.

Dr. Chase's Inguinal Truss, for common or simple Inguinal Herniæ.

FIG. 1



a The block and block-attachment.
b The part of the spring which bears the greatest stress and requires the highest temper.
c The termination of the spring, made more flexible, and extending to the edge of the os ilium between the two spinous processes on the opposite side of the body.
d The back-pad seen in situ.
e The perineal strap with its end thrown round the extremity of the spring-cover.

This figure represents the general outline of all the single instruments. Those peculiarities which render them applicable to the different kinds of rupture, remain to be noticed.

The perineal strap *e*, is always found attached to these instruments.

The dorsal pad, *d*, which is novel in its arrangement, consists of a circular disk of metal covered with buckskin. It is attached to the spring by a leathern loop, permitting it to be moved to either side at will. By this arrangement, the back and spine are relieved from that irritation and consequent inflammation which not unfrequently result from the pads of Hull and others, which are immovable, and which sometimes lay the foundation of serious diseases in those parts.

Chase's common Inguinal Block, with attachment.

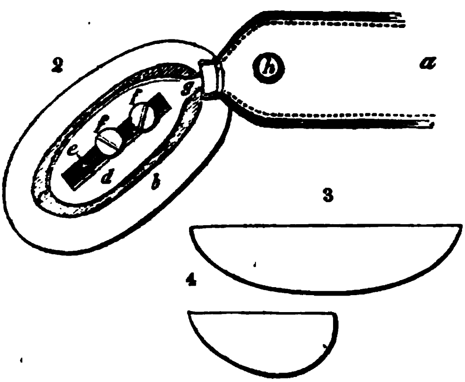


Fig. 2.—*a* The extremity of the main-spring of the truss.
b The block.
c The brass block-rider: the screws by which it is attached being covered by the block-slide.
d The block-slide.
e The window in the block-slide.
f f The two broad-headed screws of the block-adjustment, securing the rider to the slide, and, when loosened, sliding freely in the window.
g The soft iron flexible neck, attaching the block-slide to the main-spring.
h The button for the pelvic strap, which is generally used for the perineal strap also.

The proper perineal strap-button on the end of the block-slide is omitted in this and some succeeding figures, to prevent confusion.

Fig. 3—Longitudinal section of the block.

Fig. 4—Transverse section of the same.

The block *b*, of this instrument may be described as consisting of a longitudinal section of an oval spheroid, moulded by a force producing some flatness on one side. When applied, it extends from the pubic bone along the rout of the inguinal canal to a few lines above the internal ring, giving equal pressure and perfect security against the escape of the viscera throughout its whole extent. In this form of hernia we are advised the pressure should be made over the *internal abdominal ring*, extending as a further protection along the rout of the canal.

Having analyzed the several parts of the Inguinal Truss of Dr. Chase, the committee say that they felt bound honestly to state their conviction that this instrument surpasses all others known to them in the accuracy and permanence of its retentive power in common Inguinal Hernia; a conviction fully sustained by all their practical observations of the action of trusses. The instrument is worn with so much comfort, that patients generally relinquish it unwillingly, and have sometimes *absolutely refused so to do* even when pronounced well by the Surgeon.

The committee did not find themselves able to suggest any improvement, or to point out any defect of principle or construction in this truss as now employed by the inventor." See Rep. p. 555, Amer. Jour. Med. Soc.

Chase's Ventro-Inguinal block, with attachment.

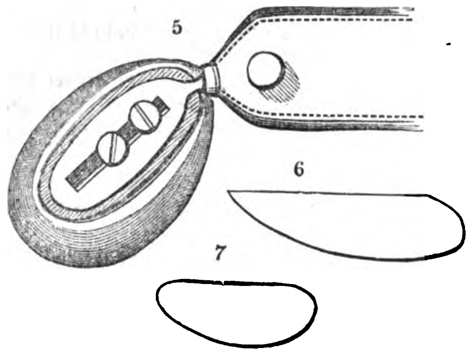


Fig. 5.—The attachment being in all respects similar to that in fig. 10, no references are required.

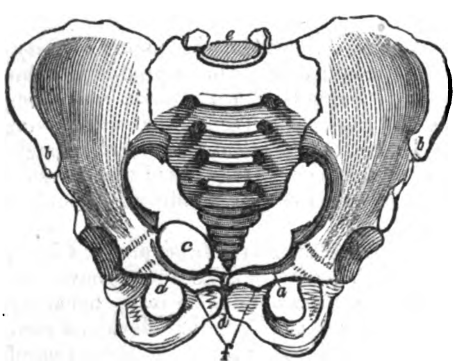
Fig. 6.—Longitudinal section of the block.

Fig. 7.—Transverse section.

The block of this instrument, resembles the common Inguinal truss-block, strongly compressed at its broader convexity, and made to overhang its base, so as to be adapted accurately to that part of the pubic bone over which the bowel passes in Ventro-Inguinal hernia.

In this variety of the disease, the pressure is given *over the external ring* and very near to the pubic bone. The following cut illustrates the position here taken.

Fig. 8.—A view of the pelvis, with Chase' Ventro-Inguinal block in situ—to show the adaptation of its curvature to the form of the body and spine of the os pubis.



a a The bodies of the pubic bones.
b b The anterior superior spinous processes of the ilia.
c The ventro-inguinal block in situ.
d The symphysis pubis.
e The base of the sacrum.
f The spines of the pubic bones.

The only part peculiar in this truss is the block; all the others are identical with the Inguinal Truss of Dr. Chase.

"The form of Chase's ventro-inguinal block is so accurately adapted to that of the os pubis, that it has secured the bowel perfectly in every instance of ventro-inguinal hernia in which it has been seen applied by the committee."

"To the complete instrument, as it has been actually employed by the inventor during the last year, the committee may safely apply the same language used in concluding their remarks on the Inguinal Truss."

Rep. p. 558. Op. Cit.

Chase's Femoral block with attachment.

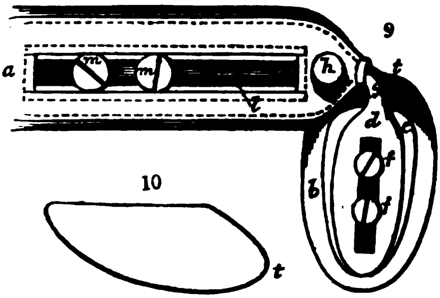


Fig. 9.—The letters from *a* to *h*, inclusive, have the same reference as in fig. 2.

k A window in the anterior extremity of the main-spring.

l The iron neck of the block-slide continued along the main-spring for some inches and seen through the window *k*.

m m Two broad-headed screws of the spring-adjustment, securing the flattened extremity of the iron neck to the main-spring, and, when loose, permitting it to slide on the main-spring.

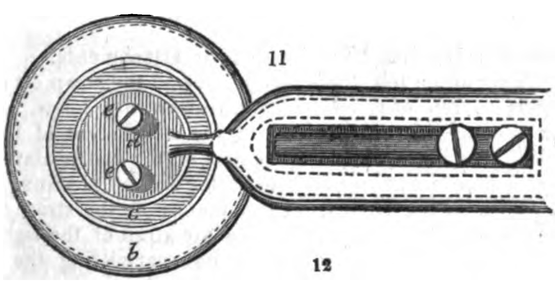
Fig. 10.—A longitudinal section of the femoral block.

The block of this instrument resembles a hen's egg held in a perpendicular position, with its larger end upwards, and flattened on one side, to which the block-rider (*c* fig. 9) is secured. Its pressure is made between the femoral vein and the os pubis, and over the site of the femoral ring; while the upper extremity (*t*) affords its pressure below Poupart's ligament.

This block has a double adjustment, one at (*f f*) enabling the surgeon to raise or depress the block at will, and a second, regulated by the screws (*m m*) to meet the peculiarities of individual pelves in regard to the distance between the wing of the ilium and the femoral ring. This double adjustment is undoubtedly novel, perfectly secure and accurate.

The spring of this instrument with its appendages, is similar to the instruments before described.

Fig. 11.—*Chase's Umbilical Block and Attachment.*



a The anterior end of the spring, with the same kind of spring-attachments as in the femoral truss.

b The circular block.

c The circular block-rider.

d The circular iron disk supporting the block-rider.

e e Two button-headed screws attaching the rider to the disk, and serving at the same time to secure the strap.

Fig. 12.—Section of the circular block.

The novelty in this block consists in its central prominence, which may be raised on its convex face to any degree required. This prominence is a segment of a much smaller sphere than the margin of the block *b*. The central prominence is made broader or narrower, is more or less raised according as the case under treatment requires; and in employing the umbilical truss, the inventor is desirous of pressing back the ruptured or dilated parts, to the situation in which nature would have retained them, had union taken place at the umbilicus at birth.

The dorsal-pad of this instrument is oblong, and is attached to the spring by two loops.

Scapularies are sometimes used with this instrument.

Fig. 13.—*Chase's Double Truss—prepared for a double Inguinal Hernia.*

FIG. 13.

a The two common inguinal blocks with their attachments.
b The spring-cover of the left truss terminating in the strap *c c c c*.
c c c c The pelvic strap of the left truss, thrown into loops, and passing through an opening beneath the base of the attachment of the strap on the right side at *e*, like the flexor tendons of the last phalanx of the fingers through the terminations of those of the second phalanx.
d The spring-cover of the right truss terminating in the strap *f f f f*.
e The site of the commencement of the pelvic strap of the right truss, secured by the edges to the spring-cover, but permitting the left pelvic strap to pass up from under its base so as to become superficial in the rest of its course: this arrangement being concealed by the instrument.
f f f f The pelvic strap of the right truss thrown into loops.
g g g g g Loops confining each pelvic strap respectively to the spring-cover of the opposite truss.
h The two springs seen one behind the other, and naked, between the ends of the spring-cover.
k k Dotted lines representing the spots where the spring of each truss terminates within the spring-cover of its fellow.
l A dotted line representing the proper position for the back-pad.

Of all the various apparatus for the treatment of hernia, not one specimen exhibited so perfect a combination of springs and their appendages, or

embraced so complete an assemblage of mechanical advantages applied to the retention of hernia, as this instrument. The chairman of the committee in noticing this instrument, uses the following language. "Since the preliminary report was read, Dr. Chase has invented the admirable instrument now for the first time presented to the society. It is an association of two single trusses, so combined as to be perfectly independent in their action, without the slightest mutual interference, yet so associated by means of the straps and loose spring-covers, that they present the appearance, and act with all the convenience of a single instrument. Each spring, at its posterior extremity, re-enters the spring-cover of its fellow, and the strap of one truss passes smoothly through a passage beneath the commencement of that of the other, so that both sides appear symmetrical, as far as the springs and appendages are concerned, and the straps do not in the slightest degree embarrass each other. As the peculiarities of this instrument are confined to the spring-covers and straps, which are suited alike to the trusses for inguinal, ventro-inguinal, and femoral hernia, the instrument can be adapted at a moment's notice, to any possible combination of these three forms of the disease, so long as the varieties exist on opposite sides of the abdomen.

"The committee cannot speak too highly of this beautiful invention, but it may be safely permitted to speak for itself."

We have now reviewed in a cursory manner the instruments of Dr. Chase, and we only regret that the limits afforded, will not permit us to enter more fully into the subject. The cuts, however, of which we have availed ourselves in this instance, will in a great degree enable the reader to estimate the value of the improvements.

From a review of the whole subject as presented in the report, it may be fairly averred that Dr. Chase has closely studied the anatomy of hernia, that he has manifested great mechanical skill in the construction of his instruments, and that he is intimately acquainted with the action of trusses generally. Whether a set of instruments can be devised better calculated to fulfil all the indications required for the successful treatment of this very troublesome malady, may admit of much doubt; with our present knowledge of the disease, improvement seems scarcely desirable.

The patentee's claims, making a part of the specification of his patent, are as follows:—

"Notwithstanding that I have in the preceding specification set forth by an exact description the instruments as used by me in the cure of the different kinds of hernia, and have given particular admeasurements for springs, blocks or pads, &c.; still I wish to be particularly understood that in all cases of hernia I vary my treatment in relation to the size of instruments, agreeably to the age of the patient and state of the case, governing myself according to existing circumstances, but at all times adhering to the principles set forth in this specification. In my apparatus, and the several instruments of which it is composed, the pads or blocks are adapted to the several varieties of hernia with due and strict attention to the anatomical and physiological peculiarities of the parts interested in the several varieties of the disease, the said pads or blocks being so constructed and attached as to secure the permanent and certain retention of the bowel in all cases which admit of retention by mechanical means, thus allowing the powers of nature, if possible, to close the orifice by which the bowel escapes from the cavity of the abdomen in this disease, which result is not obtained with certainty by any other instruments previously invented.

"I claim the peculiar mode of attachment for the block, as given in the

description of each instrument, including the block-slide adjustment of the inguinal and ventro-inguinal trusses, and the block-slide adjustment, and the spring adjustment of the femoral truss, and spring adjustment with the permanent block attachment of the umbilical truss.

"I claim also the new method of employing dorsal pads in all the trusses, by which method the said pads are made movable, so as to slide to any distance which may be required.

"I claim the peculiar double truss herein described, namely, the employment of two springs sliding upon each other with pads or blocks attached and combined in such a manner as to act like one entire instrument, by whatever arrangement of the springs and straps such a result may be obtained.

"Lastly, I claim the several improvements which have been described and specifically claimed independently of the material of which they may be constructed, and whatever alterations in form or size they may hereafter undergo, so that similar effects are produced by analogous means.

"For a further illustration of the peculiarities, and construction, and form, upon which the operation of the foregoing instruments are dependent, I refer to the drawings with written references thereto, deposited by me in the patent office, in compliance with the requirements of the patent law."

The committee thus conclude their remarks upon the instruments of Dr. Chase:—

"After all that has been stated, the committee feel themselves fully warranted in the following conclusions.

"1. The retentive power of solid blocks is, *cæteris paribus*, superior to that of soft pads in the treatment of hernia, as has been already stated in the Preliminary Report.

"2. The chances of radical cure depend upon the perfection and permanence of the retention.

"The perfection and permanence of the retention depend—first, upon the mechanical action of the instruments; and, secondly, upon the power of the parts affected to bear that action without danger of physiological accidents of sufficient importance to interfere with the treatment.

"4. All the instruments with solid blocks contrived before the recent inventions of Dr. Chase, are decidedly liable to important mechanical objections, and all of them, with the exception of the Rachet truss, are moreover capable of producing physiological accidents of sufficient importance to interfere with the treatment.

"5. The construction of the Rachet truss is such as to render retention uncertain, even in ventro-inguinal hernia, to which form of the disease alone, it is tolerably will adapted.

"6. The instruments of Dr. Chase have effected the permanent and accurate retention of the intestines in every case of hernia observed by the committee, without material inconvenience to the patient, and often under trials more severe than are usually ventured upon by those who wear other trusses; trials which would be imprudent with any other apparatus known to the committee.

"7. If we except the femoral truss, these instruments have stood the test of much practical application, without superinducing any physiological accidents of sufficient importance to interfere with the treatment.

"8. The mechanical principles upon which the femoral truss is constructed, appear highly ingenious and promising; and unless this instru-

ment should be found hereafter to be productive of important physiological accidents, it must take precedence of all other modes of treating this variety of the disease. No such accidents are yet known to have been produced by its employment; but the committee have not enjoyed the opportunity of personal inspection in a sufficient number of cases to determine general results, nor do they deem it proper to receive evidence from any other quarter in discharging the trust reposed in them by the society.

"The committee are induced, by the foregoing conclusions, to recommend in strong terms, the instruments of Dr. Chase to the confidence of the profession, as the best known means of mechanical retention in hernia, and as furnishing the highest chances of radical cure."

Franklin Institute.

Annual Meeting.

The Annual Meeting of the Institute was held at their Hall, on Thursday evening, January 18th, 1838.

James Ronaldson, Esq., President, in the chair.

Solomon Roberts, Esq., Recording Secretary, pro. tem.

The minutes of the last Quarterly Meeting were read and approved.

Donations of books were received from the Zoological Society of London; the Royal Geographical Society of London; Mr. John Gummere, of Haverford, Pa.; Mr. Samuel Colman, of New York; and A. L. Elwyn, M. D., R. Bridges, M. D., Heber Chase, M. D., and Mr. Robert Davis, of Philadelphia.

The Actuary laid on the tables the periodicals received during the past quarter in exchange for the Journal of the Institute.

The Annual report of the Board of Managers was read, and, on motion, was accepted, and referred to the Committee on Publications.

The Treasurer presented his report of the funds for the last quarter, and also a statement for the year ending December 31st, 1837—which were read and accepted.

The Committee on Publications presented their report on the operations of the Journal of the Institute for the year ending December 31st, 1837, which was read and accepted.

Mr. John Horton, from the Committee of Tellers of the election for officers and managers of the Institute for the ensuing year, (appointed at the preparatory meeting this day,) presented their report of the result of the election, when the President declared the following gentlemen as duly elected:

James Ronaldson, President.

Isaiah Lukens,
Thomas Fletcher, } Vice Presidents.

Isaac B. Garrigues, Recording Secretary.

Isaac Hays, M. D., Corresponding Secretary.

Frederick Fraley, Treasurer.

Managers.

Samuel V. Merrick,	John C. Cresson,
Abraham Miller,	James M. Linnard,
William H. Keating,	Andrew M. Eastwick,
John Struthers,	Isaac P. Morris,
Matthias W. Baldwin,	Charles B. Trego,
Alex. Dallas Bache,	Henry Troth,
Jas. Henry Buckley,	John S. Warner,
Alexander Ferguson,	William H. Carr,
John Agnew,	*Robert M. Patterson,
John Wiegand,	*Henry D. Rogers,
Alexander M'Clurg,	*John Gilder,
Samuel Hufty,	*William D. Parrish.

(Extract from the minutes.)

James Ronaldson, *President.*

Solomon W. Roberts, *Rec. Sec. P. T.*

Fourteenth Annual Report of the Board of Managers of the Franklin Institute.

On the return of the period which terminates their official career, the Managers of the Franklin Institute present to their fellow members their Fourteenth Annual Report.

It is with sentiments of unalloyed satisfaction, that the managers feel themselves authorized on this occasion, to renew their congratulations upon the continued success which has attended the labours of the Institute, in its useful and unpretending career.

Notwithstanding the temporary cloud, which has cast so deep a shadow over our recent manufacturing prosperity, the Institute has continued to receive the undiminished support of its members; and has, in return, imparted to them its accustomed, varied, gifts of knowledge, by means of its lectures and drawing school, its library and cabinets of minerals and models, by the social and informal interchange of opinion and experience at the Monthly Conversation Meetings, and by the valuable fund of practical and scientific information, spread upon the pages of its Journal.

Nor have its benefits been diffused only within the circle of its own members, widely as that circle is now extended.

The Committee on Science and the Arts, have maintained their zeal and activity, with no other incitement than the love of doing good; and will have contributed no small share of disinterested exertion to the common weal.

Number of new subjects brought before the Committee	37
Do. lying over from last year - - -	8
	45
Do. disposed of by report or otherwise -	41
Do. remaining for future action - -	4

The Committee on Explosions of Steam Boilers, after a laborious investigation, continued during four successive years, have completed the task assigned to them; and their reports to the government of the United States

*New members.

have furnished a fund of valuable materials, which may constitute the basis of patriotic and wise legislation for the protection of the lives and property of our citizens.

The Committee on Weights and Measures, after reporting to the legislature of this state, a projećt of laws for ensuring a uniform system, have been engaged in maturing the plan for carrying the law into effect; and are now prepared to verify the standards of weights and measures, whenever the requisite authority shall be delegated to them by the Executive.

In the early part of last year, the Board decided that it was inexpedient to hold the usual exhibitions of American manufactures, on the return of the biennial period in the autumn of 1837. Although this decision was not founded upon any anticipation of the general paralysis of business, which has since occurred; an additional cause for approval of their course is found in the almost total cessation of manufacturing operations, attending the commercial derangements. As some comment has been made upon the temporary discontinuance of our exhibitions; and the supposition has been entertained, that the omission last year arose from a want of zeal on the part of our members, the Board deem it but just, to lay before the Institute the views on which their decision was founded; leaving it to their successors to determine how far these views shall continue to influence their future course.

At the time when the Franklin Institute first started into existence, the manufactures of Philadelphia, and indeed of the whole Union, were in a condition of weak and destitute infancy. The mechanics of the country were unaided by the enlightening influence of science; and had not yet learned to avail themselves of that great lever of social prosperity, the systematic and free interchange of ideas, and co-operation of interests.

The primary object, therefore, of the Institute at this period, was, to effect an extensive and intimate acquaintance between the various classes of manufacturers, and likewise between the producer and the consumer.

A rapid series of improvements in the arts, partly the cause, and partly the effect, of the exertions of the Institute, called for the frequent repetition of exhibitions, designed to keep the public mind informed of the progress of our domestic industry.

But that state of infantile weakness, and of rapid change, has now in a great measure passed away; and the more mature and steady growth of the arts, does not require, and would not repay the labour of such frequent displays. They were originated with a view to the benefit of the community, and should be continued no longer than the interests of society require. The energies of the institute have become too valuable to be expended in getting up a mere idle pageant.

It is believed, however, that exhibitions of domestic manufactures, of a character worthy the true friends of the arts, might be held at periods of four or five years; which would allow a sufficient lapse of time for the development of important and interesting improvements; and would thus retain their character of novelty and usefulness.

Although any self gratulation on the subject at this time may seem premature, the Board cannot close their report without expressing their sanguine hopes, of the speedy development of a feature of the Institute, which has been warmly cherished in prospect from the earliest days of the society. In their first annual report, the Managers of the Institute suggested the establishment of a school of arts, in which the mechanic, the manufacturer, the miner, and the civil engineer, might receive instruction in all the sciences which have a practical bearing upon their several pursuits; and from that

period the Institute has been anxiously looking forward to the time when public opinion should be sufficiently awakened to the vast importance and utility of such an institution.

It is confidently believed that the time has now arrived, in which enlightened legislation, on a subject so deeply interesting to the community at large, and to the mining, manufacturing, and agricultural population of our own state in particular, will be sustained by acclamation, from one extremity of the commonwealth to the other.

There has, probably, never been any public measure pressed upon the attention of our legislature, which has met with more cordial and unanimous approval, from men of all parties and all conditions in society. The conviction being universally entertained, that the claims of the productive classes of the community, upon legislative munificence, are strong and imperative.

The Committee on the Chesnut Street Hall, have effected some further sales of the loan during the year; but have not yet disposed of a sufficient amount to warrant them in carrying into effect the improvements necessary to fit the building for the purposes of the Institute. The property at the present time yields an income beyond the interest on its cost, and there is no reason to doubt that it will continue equally productive until more auspicious times shall enable them to complete the intended alterations, and thus increase the accommodations of the Institute to the extent which its large list of members requires.

During the past year the Institute has elected 188 new members. 93 have been lost by resignation, and 23 by death. Increase during the year 72. Whole number of members 2078.

The following named gentlemen have become life members: Messrs. J. J. Barras, Thos. Earp, Davis Henderson, Jno. K. Kane, Wm. McIlvaine, Israel Morris, Wm. S. Otis, Solomon W. Roberts, Return Sheble, Thos. S. Stewart and Jos. Saxton.

John Struthers, *Chairman.*

William Hamilton, *Actuary.*

Report on Prof. Morse's Electro-Magnetic Telegraph.

THE COMMITTEE ON SCIENCE AND THE ARTS constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, an Electro Magnetic Telegraph invented by Professor F. B. Morse, of the city of New York, REPORT,

That this instrument was exhibited to them in the Hall of the Institute, and every opportunity given by Mr. Morse and his associate Mr. Alfred Vail, to examine it carefully, and to judge of its operation; and they now present the following as the result of their observations.

The instrument may be briefly described as follows:

1st. There is a galvanic battery of sixty pairs of plates, seven by eight and a half inches each, arranged according to the very convenient plan devised by Prof. Hare, and set in action by a solution of sulphate of copper.

2d. The poles of this battery can be connected, at pleasure, with a circuit of copper wire, which, in the experiments we witnessed, was ten miles in length. The greater part of the wire was wound round two cylinders, and the coils insulated from one another, by being covered with cotton thread.

3d. In the middle of this circuit of wire,—that is at what was considered

virtually a distance of five miles from the battery, was the *register*. In this there is an electro-magnet, made of a bar of soft iron bent in the form of a horse-shoe, and surrounded by coils of the wire which forms the circuit. The *keeper* of this magnet is at the short arm of a bent lever, at the end of the longer arm of which is a fountain-pen. When the keeper is drawn against the magnet, the pen comes in contact with a roll of paper wound around a cylinder, and makes a mark with ink upon this paper. While the telegraph is in operation, the cylinder which carries the paper, is made to revolve slowly upon its axis, by an apparatus like the kitchen jack, and is at the same time moved forward so that the pen if constantly in contact with the paper would describe a spiral or helix upon its surface.

4th. Near the battery, at one of the stations, there is an interruption in the circuit, the ends of the separated wire entering into two cups, near to each other, containing mercury. Now if a small piece of bent wire be introduced, with an end in each cup, the circuit will be completed, the electro-magnet at the other station will be set in action, the keeper will be drawn against it, and the pen will make a mark upon the revolving paper. On the other hand, when the bent wire is removed from the cups, the circuit will be interrupted, the electro-magnet will instantly cease to act, the keeper will, by its weight, recede a small distance from the magnet, the other end of the lever will rise and lift the pen from the paper, and the marking will cease.

5th. The successive connexions and interruptions of the circuit, are executed by means of an ingenious contrivance for depressing the arch of copper wire into the cups of mercury, and raising it out of them. This apparatus could not be described intelligibly without a figure; but its action was simple, and very satisfactory.

6th. Two systems of signals were exhibited, one representing numbers, the other letters. The numbers consist of nothing more than dots made on the paper, with suitable spaces intervening. Thus ... . would represent 325, and may either indicate this number itself, or a word in a dictionary, prepared for the purpose, to which this number is attached. The alphabetical signals are made up of combinations of dots and of lines of different lengths.

There are several subsidiary parts of this telegraph which the committee have not thought it necessary to mention particularly. Among these is the use of a second electro-magnet at the register, to give warning by the ringing of a bell, and to set in motion the apparatus for turning the cylinder.

The operation of the telegraph, as exhibited to us, was very satisfactory. The power given to the magnet at the register, through a length of wire of ten miles, was abundantly sufficient for the movements required to mark the signals. The communication of this power was instantaneous. The time required to make the signals was as short, at least, as that necessary in the ordinary telegraphs. It appears to the committee, therefore, that the possibility of using telegraphs upon this plan, in actual practice, is not to be doubted; though difficulties may be anticipated which could not be tested by the trials made with the model.

One of these relates to the insulation and protection of the wires, which are to pass over many miles of distance, to form the circuits between the stations. Mr. Morse has proposed several plans,—the last being to cover the wires with cotton thread, then varnish them thickly with gum-elastic, and enclose the whole in leaden tubes. More practical and economical

means will probably be devised; but the fact is not to be concealed that any effectual plan must be very expensive.

Doubts have been raised as to the distance to which the electricity of an ordinary battery can be made efficient; but the committee think that no serious difficulty is to be anticipated as to this point. The experiment with the wire wound in a coil may not, indeed, be deemed conclusive; but one of the members of the committee assisted in an experiment in which a magnet was very sensibly effected by a battery of a single pair through an insulated wire of 2½ miles in length, of which the folds were four inches apart; and when a battery of ten pairs was used, water was freely decomposed. An experiment is said to have been made with success, on the Birmingham and Manchester rail-road, through a circuit of thirty miles in length.

It may be proper to state that the idea of using electro-magnetism for telegraphic purposes has presented itself to several different individuals, and that it may be difficult to settle among them the question of originality.

The celebrated Gauss has a telegraph of this kind in actual operation, for communicating signals between the University at Gottingen and his magnetic observatory in its vicinity. Mr. Wheatstone of London, has been for some time also engaged in experiments on an electro-magnetic telegraph. But the plan of Professor Morse is, so far as the committee are informed, entirely different from any of those devised by other individuals, all of which act by giving different *directions* to magnetic needles, and would therefore require several circuits of wires between all the stations.

In conclusion the committee beg to state their high gratification with the exhibition of Prof. Morse's telegraph, and their hope that means may be given to him to subject it to the test of an actual experiment made between stations at a considerable distance from each other. The advantages which this telegraph would present, if successful, over every kind heretofore used, make it worthy of the patronage of the government. These are, that the stations may be at a distance asunder far exceeding that to which all other telegraphs are limited,—and that the signals may be given at night and in rains, snow, and fogs, when other telegraphs fail.

(By order of the Committee.) William Hamilton, *Actuary.*
Philadelphia, February 8th, 1838.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MAY 1837.

With Remarks and Exemplifications by the Editor.

82. For *a Turning Table for rail-roads*; Jeremiah Myers, Attleborough, Bristol county, Massachusetts, May 8.

There is to be a revolving platform constructed much in the usual way, but it is to be placed upon a carriage with rollers running upon a rail over the pit prepared for the turnabout, which pit may be two or three times as long as it is wide, or as the diameter of the turnabout, which may be drawn along it by means of a chain and windlass. The ends of the pit are circular, and the turning table is to be moved round by a pinion taking into teeth on its lower side.

"The invention claimed consists in placing the revolving circular platform, or turning table, upon a carriage moving upon rails; in making an oblong pit by which the locomotive engines or cars may be run off the turning table at right angles from any part of the pit; and from

either end obliquely as well as at right angles, or otherwise, to any part of the work-shop, depot, carriage-house, or other place; and in the facility afforded from the above described form of the pit, of clearing the turning table from snow, ice, or other obstructions: likewise in placing the locomotive engine on a car upon a carriage running at right angles with the track, by which means the locomotive or car may be run off upon any other track parallel with the same. A revolving circular platform, or turning table, is not claimed, but only the method of turning it by the use or application of a circular rack and pinion turned by a crank."

Possibly such a contrivance as the foregoing may be found useful in a workshop, or depot, but it is not likely that it will be applied elsewhere. The latter claim to the circular rack and pinion would scarcely be sustainable; and some of the former claims are to results instead of to the means by which they are produced.

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83. For an *Iron Chest, or Safe*, for the preservation of Books; Benjamin Sherwood, city of New York, May 8.

This chest, safe or bookcase, is to be made in the form of a vertical cylinder. Its security is to result from there being two double cases each filled with a bad conductor of heat. The outer case is a double cylinder, with double heads, a space of about two inches between the two being filled with a mixture of prepared Plaster-of-Paris, and pulverized charcoal. The inner case is similarly made, there being a space of about an inch between it and the outer; it revolves on central gudgeons, has its proper door, which when closed is to be turned round so as to be on the side opposite to that of the outer case.

The claim is to "the principle of suspending by pivots, one safe within another, that the door of the inner one may be shut, and it turned round and secured so as to place the door of the inner and outer safes in different directions from each other; that if by a fall of any great weight upon it the outer door should be thrown open, the inner one being turned round would prevent any exposure of the contents: second, the application of pulverized charcoal and boiled gypsum combined, in fire proof chests, as a non-conductor of heat.

Double chests failed in the intense heat of the fire in New York, and there does not appear to be any thing special in that presented to us above, to protect it under similar circumstances; the mixture of charcoal and gypsum will do no more good than charcoal alone, or various other bad conductors of heat, or, in fact, than a mere air chamber.

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84. For a machine for *Facing and Dressing Stone;* David Hull and John Critcherson, Portland, Cumberland county, Maine, May 8.

The cutting is to be effected by chisels, or cutters, projecting out from a quadrant of a cylinder, which is to be vibrated backward and forward above the stone, being caused to do so by the action of a crank shaft, and fly wheel. The cutters are to be forked, so as to have two edges, and it is said that they will sharpen themselves by their vibratory motion. Perhaps they may, but to us the motion seems well calculated to produce a contrary effect. The claim is to "the double edged cutters placed upon a segment of a cylinder, having a pendulous mo-

tion, for cutting and dressing stone, substantially as set forth in the specification."

85. For a machine for *Cutting and Dressing Granite, Marble, or other Stone*; John D. Buzzell, Cape Elizabeth, Cumberland county, Maine; first patented June 2d, 1836, re-issued on an amended specification, May 15.

The description of this machine is of great length, referring throughout to accompanying drawings. The claims made are to "the particular arrangement and combination of the cutting and polishing cylinders; the chisels or cutters used for cutting, grooving, beading; the method of raising and regulating the material to be operated upon, and the arrangement of the machinery for revolving and moving the cylinders, and moving the carriage."

The chisels for cutting, adapted in shape to the particular purpose for which they are to be used, are fixed in sockets set in spiral rows round a hollow cast iron cylinder, and these, it is said, are to "strike upon the stone in such a manner as to cut the stone and dress and polish it fit for building." The peculiar form of the chisel is described, and is such that it may be shifted in its socket as it wears, and so secured as to present a new cutting edge. There are to be cylinders of stone for grinding and polishing after the cutting; and a wooden cylinder covered with leather, to be used with emery, &c., for the same purpose. How far some of the things claimed may be sustainable, we are not prepared to say; we allude to such as the method of raising and regulating the material. We have not seen this machine in operation, but from those who have we have received very favourable reports. We look for one to be brought to Washington, to be tried on stone for the public buildings.

86. For improvements in the *Air Pump for Low Pressure Steam Engines;* Thomas B. Silliman, city of New York, May 15. (See specification.)

87. For an improved mode of *Running Saw Mill Gates upon Irons;* Henry Johnson and Nelson Johnson, Erwin, Steuben county, New York, May 15.

This patent is taken for a trifling alteration in the mode of constructing slides, or guides, of metal, for a saw gate; the claim made is to what is denominated a "spring wedge, for pressing up the box against the slide." This particular contrivance it is not considered worth while to describe, as the making a good slide is a thing of no difficulty whatever.

88. For a machine for *Cutting, Grinding, and Polishing Granite, Marble, and other kinds of Stone;* Mighill Nutting, Portland, Cumberland county, Maine, May 15.

The patentee says, "I claim as my invention, the hemispherical nuts, as arranged, for raising, and regulating the height of the stone to be cut, ground, or polished. I also claim the particular manner in which I have arranged the springs above the hammers, and those which sustain the chisels upon shafts, by means of which they can be simultaneously

raised and lowered. I also claim the manner in which I have arranged and combined the respective parts of the cutter frame, so that the position of the chisels, and of the other parts connected therewith, may be regulated by the turning of the cutter frame upon its axis; and the manner of vibrating this frame by a lateral motion communicated to the said axis."

The hemispherical nuts are set into concave beds, on which they have free motion, so that the screws which are used to regulate the height of the stone, may always turn without binding. The cutters are raised by means of lifters on a revolving shaft, and are so fixed as that the feed of the whole of them may be regulated simultaneously. The chisels are raised to a given height, by means of springs, which are also capable of simultaneous regulation.

The subject of stone cutting machines has arrested the attention of several different inventors within a short period of time, most probably in consequence of the very favorable reports of the success of the machine invented and patented by Mr. Hunter, of Scotland.

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89. For a *Machine for Cutting Grass and Grain;* Alexander M. Wilson, Rhinebeck, Dutchess county, New York.

This is a renewed patent, issued in consequence of the destruction of the original by fire, at the time the patent office was burnt. This patent was noticed at p. 48, vol. xviii. There appears to be some discrepancy between the claims made in the original patent, as there stated, and those in the renewed instrument. The following are the words of the claim as now presented. "What I claim as my invention in the foregoing machine, is the construction of what I call the gathering wheel, with its offsets, made in the way described, and having knives or cutters attached to its lower side; the whole formed and operating substantially in the manner herein set forth."

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90. For improvements in the *Machine for cutting Grass and Grain;* Alexander M. Wilson, Rhinebeck, Dutchess county New York, May 15.

The claim under this patent for an improvement on that last noticed, embraces a sliding gear above the gathering wheel, in combination with a hinge guard plate under the front edge of the wheel, and the clutch box upon the shaft, to allow of the adaptation of the knives and gathering wheel to uneven ground; and also to the manner of balancing the machine.

A machine very similar to this, in appearance, is shown in Loudon's Encyclopedia of Agriculture, p. 422, third edition. The gathering wheel and knives, however, are circular, instead of having breaks, as in Mr. Wilson's. We believe that the difficulties which presented themselves in the Scotch machine have not been removed; there appears to be too much complexity in the instrument itself, and a considerable waste of power in moving the gathering wheel and its load, where the crop is heavy.

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91. For *Boats for Canals, Bays, &c.;* Abraham Morrison, Johnstown, Cambria county, Pennsylvania, May 15. (See specification.)

92. For a new and improved *Mode of Propelling Boats;* Jesse Ong, North Huntingdon, Westmoreland county, Pennsylvania, May 23.

The claim is to "the application of two paddle wheels for the purpose of propelling boats, at the centre of the stern, and having that centre as the common focus of their motions, which are contrary in direction, and their planes at right angles instead of parallel with the direction of the boat, and the direction and order of their strike is such that the created currents, whilst they assist the efficacy of the wheel, are themselves dissipated and destroyed by their successive action on each other."

The paddles are set obliquely to the hub, or centre, of the propelling wheels, which are parallel to, and in the vicinity of, each other. The shaft of one wheel is hollow, to allow that of the other to pass through it, as they are to be propelled in reverse directions, the obliquity of the paddles being reversed.

Attempts have been made to propel boats by means of wheels like the foregoing, but, we believe, on separate axes. How far the reversed force acting upon the water will still the agitation, we are not prepared to say; this must be determined by experience; we, however, do not believe that it will be such as to have much effect in preventing the washing of the banks of canals; the only situation where such an affair is of importance.

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93. For a *Steam Regulator to prevent Explosions in Boilers;* Augustus Eitelgeorge, Cincinnati, Hamilton county, Ohio, May 23.

A boiler is to be made in any of the usual forms, and a second vessel is to be made of the same form, but less in its dimensions, so that when placed within the first there shall be a space of four or five inches between them; the inner vessel, which is called a steam regulator, is to be perforated with numerous holes over its whole surface.

The claim is to "the application to common steam boilers of a perforated steam regulator, of a figure correspondent to that of the boiler in which it is placed, but of smaller dimensions, leaving a space between it and the sides and ends of the boiler, secured by rods or arms extending from the sides and ends of the regulator to the sides and ends of the boiler; the flues passing through both regulator and boiler, for preventing the bursting of the latter, by checking, breaking, or equally distributing, the power of the steam, and thus preventing its acting with too great a force on any part of the boiler."

So far as we remember, this mode of preventing explosions has not been hitherto essayed, and so far as we are able to judge upon such a subject, it never will be essayed by any one who understands any thing of the nature of steam, and who is acquainted with the vast power which has been manifested in most of the explosions which have occurred. We really think that a patent might have been fairly refused on account of the trifling nature of the contrivance; but this ground, when taken, is one of the most offensive to those who imagine that they have made great discoveries. If the thing claimed can be pointed to as having been previously done, this is considered as a mere misfortune; but to call any contrivance worthless which some one has thought worthy of a patent, is an act of the most monstrous injustice, and can arise only from ignorance or interest, or from a combination of the two.

94. For an improvement in the *Construction of Water Wheels;* Nehemiah P. Stanton, Syracuse, Onondagua county, New York, May 23.

Some variations in the mode of constructing this wheel are described, but, in general, it is to be made by forming spiral wings, or floats, on the two ends of a horizontal shaft, and covering these with a tight drum or case. The outer ends of the drums, are enclosed, there being perforations on their peripheries close to the heads, through which the water is to escape from the spirals. The shaft which connects these two wheels passes through an opening at the lower end of a trunk, or floom, against the sides of which the open ends of the drums fit and revolve, and through which they receive their water. The invention claimed, "is the conducting of the diagonal or spiral tapering buckets, with the discharge of the water in the extreme surface of the wheel, or at the point of greatest length of lever."

This contrivance adds another to the catalogue of what are called reaction water wheels. It has some claim to novelty in its form, but it would not be an easy task to tell in what way this variation of form will render it a substantial improvement.

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95. For an improved *Rail for Railways;* John Ruggles, Thomaston, Lincoln county, Maine, May 23. (See specification.)

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96. For an improvement in *Fire Arms and Ordnance;* Henry C. Fay, Lancaster, Worcester county, Massachusetts, May 23.

In this instrument the barrel is connected to the stock by pivots, or trunnions, forming a hinge joint; and when the piece is to be loaded, a spring catch which holds them in place is pressed down, and the barrel depressed, so as to expose the open end of the breech, into which a ready charged metallic tube, or cartouche, is to be inserted, having on its back end a percussion cap.

By the act of loading, above described, the trigger is to be thrown out, and other movements made, preparatory to the discharge of the piece. The claims are of greater length than we think it necessary to transcribe, as they refer to certain peculiarities of structure upon which the patentee must depend for the maintenance of his right, which, however, is not, we think, very likely to be controverted, if controversy is at all dependant upon the actual use of the invention.

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97. For a new mode of *Applying Water to Tub Wheels;* David B. Napier, Liberty, Casey county, Kentucky, May 23.

The claim made is to "the application of water to tub mill wheels by two shoots, through a block or blocks, graduated so as to keep the column of water solid, and acting upon the wheel by pressure; also the band to prevent the escape of water." The two shoots deliver the water at opposite points, and each is to extend one third of the way round the wheel. Particular calculations are furnished for the exact proportions of the various parts, but still there is a want of clearness in the description, which the drawing does not entirely remove.

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98. For an improvement in *Stoves;* Ethan A. Andrews, Boston, Massachusetts, May 30.

We are told that the "invention consists in a part called the *radiator,*

which is placed behind the stove, and which may be attached to all kinds of stoves, whether close or open, whatever be the fuel used in them, provided the smoke and gases are carried from them by pipes."

The radiator is formed by two plates of metal an inch or more apart, enclosed at the edges, and it is placed at the back of the stove. Its appearance being something like that of a chimney board, but is to stand out from the fire place, or wall, so that both its sides may be exposed. A pipe leads into it from the back of the stove, and may, when desired, pass directly thence into a chimney, but by closing a valve the draught is made, by means of partitions, to circulate up and down between the two plates of the radiator, whence it escapes through two other pipes into the chimney. The radiator is in effect, therefore, a flattened pipe, or flue, for the distribution of heat. The claim is to "the combination of the stove radiator with its partitions and flues, constructed in the manner and for the purposes described."

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99. For a machine for *Drying Oil Cloths, Painted Floor Cloths, &c.;* Daniel Sampson, Winthrop, Kennebec county, Maine, May 30. (See specification.)

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100. For an *Apparatus to be used in Pointing Cannon;* John Hobday, Portsmouth, Norfolk county, Virginia, May 30.

The general construction of this apparatus is made known with sufficient clearness in the claim, as follows:

"What I claim as my invention, and wish to secure by letters patent, is the constructing of an instrument for the pointing of cannon, which instrument has an index pointing horizontally, or indicating the horizontal position and inclination of the gun to which it is attached; the position of the index being preserved by the action of a pendulous weight to which it is attached."

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101. For an improvement in the art of manufacturing *Cast Iron Cannon;* Cyrus Alger, Boston, Massachusetts, May 30. The specification of this patent will be published in an early number of this Journal.

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102. For a new mode of *Manufacturing Saddle Trees;* William Kelly, White Deer township, Union county, Pennsylvania, May 30. (See specification.)

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103. For a machine for *Hulling and Scouring Rice;* Charles K. Harvey and Erastus Tracy, Poughkeepsie, Dutchess county, New York, May 30.

This machine is constructed something like a grist mill, but instead of stones, a bed and runner of peculiar construction are employed; the lower disk forms the runner, the upper an inverted bed. The inverted bed which has a rim an inch and a half deep, is to be stuffed with curled hair, and over this is to be a covering of strong canvass, with No. 3 emery glued upon it. This is used for hulling; but when the hulled rice is to be scoured, a bed covered with lamb's skin felt, sheared so as to leave the wool three fourths of an inch long, is to be substituted.

The runner is to be constructed like the inverted bed, being, for hulling, covered with No. 3, emery, but for scouring, with emery No. 0.

The claims are to, "*First*, The particular manner of constructing the elastic bed and runner, by the use of curled hair. *Second*, The construction of the inverted bed. *Third*, The particular manner of introducing the grain between the working fans by the convex form of the runner, as shown in the drawing. *Fourth*, The particular arrangement and combination of the different parts, many of which are old, but taken together, present a new arrangement of a machine."

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104. For an improved *Cooking and Heating Stove;* Washington Auld, and James Cox, City of Philadelphia, May 30.

The claims refer to parts described in a specification of considerable length, without which, and the drawings, they would not be understood. The apparatus appears to be skillfully arranged, and we would willingly make it fully known; should the patentees hereafter furnish the necessary cuts, we will insert the specification. This we are ready to do whenever so furnished with the means.

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105. For an improvement in the *Spiral Bucket Water Wheel;* Joseph C. Green, Fayette, Kennebec county, Maine, May 30.

This water wheel consists of a cylinder grooved from end to end, like a many threaded screw, which cylinder is to be enclosed in a hollow case, or tube, which fits it as closely as may be, but within which it is to revolve; one end of the case is to have a close fitting head, and at the other, where the water is to be discharged, the head may be removed to a greater or less distance by appropriate means, and is called a ventilator. The water is, in general, to be admitted through an opening in the middle of the case, and under pressure of the head. The claims are to "The giving of the grooves or vanes of the wheel a greater obliquity at the discharging than at the receiving point. The use of a head to the cylinder to confine the pressure of the water; and the use of a ventilator regulating the discharge of the water."

We are really at a loss, after reading the specification, and examining the drawing with some care, to perceive in what the merits of the apparatus consist. We find something of novelty, but must wait to learn the amount of utility, and really apprehend that this will prove a minus quantity.

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106. For a machine for *Cleaning, Winnowing, and Separating Grain;* Markwell Thomas, Alfred, York county, Maine, May 30.

The claim in this machine is to "the employment of iron circular plates, which are bound in place by iron rods, by which the cylinders are made strong. The leaving a space between the upper and lower ends of said cylinders, and inserting in the shoulders of the inner cylinder, the iron sweeps as shown in the drawing, by which the grain is prevented from entering the joints, and the machine kept free. The employment of a spiral plate, and the mode of arranging the same by which its upper surface is left smooth and uninterrupted by fastenings. The adding a middle sieve by which the withered, defective, or imperfect grain is separated from the full and perfect grain. The double spout with doors by which the smaller or larger grain, the perfect or

imperfect of any one kind of grain, may be let into, or kept out of, the cylinder at pleasure.

It will be apparent from the foregoing, that the drawings are essential to the understanding of the particular structure of this machine.

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107. For an improvement in the mode of manufacturing *Splints for Friction Matches;* Stephen Dale, Concord, New Hampshire, May 30.

The object of this invention is security from combustion by accidental friction of the matches against each other. Dry pine, or other suitable wood, is to be cut into blocks of proper length, and one end of each block is to be grooved both ways, by saws, so as to divide it into squares of a proper size for a match. Upon the other end a piece of cloth is to be glued, and by means of a knife, or other instrument, passed into the respective grooves, the block is to be split into matches, which will be still held together by the cloth, whilst the grooved ends, upon which the composition is put, will not be in contact with each other. The claim is to this mode of manufacturing splints.

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108. For improvements in the mode of constructing *Locks for the Doors of Buildings, &c.*, and in the night latches occasionally attached to the locks of outer doors; James McClory, City of New York, May 30.

This lock is of the kind in which there is a number of tumblers capable of being changed in their arrangement, the bit of the key also consisting of separate pieces, capable of a like permutation; this being a well known device, makes no part of the claim. The tumblers are arranged in a movable box, which can be readily taken out, without otherwise disturbing the lock, when it is desired to change their arrangement; the construction and arrangement of this, forms one of the claims. There is likewise a claim to "the manner of making the key in two parts for the purpose of placing the movable bits thereon, from the upper end of the lower section." This lower section, containing the bits, has a pin which fits into the barrelled part of the upper section, where it is fastened by a wedge. One of the knobs is attached to the spindle by a nut, in a way which appears to be new, and is claimed. These, however, and a movable racking in the night latch, can not be readily understood from description.

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109. For improvements in *Many Chambered Cylinder Fire Arms;* Otis W. Whittier, Enfield, Grafton county, New Hampshire, May 30.

This many chambered gun is to have the cylinder of chambers turned by a peculiar arrangement of the parts intended for that purpose. These contrivances have become so numerous, and most of them have proved, or are in a fair way of proving, so altogether valueless, that we deem it unnecessary to attempt a description of them, unless we meet with something which takes them out of the list of mere varieties, and gives to them a specific character.

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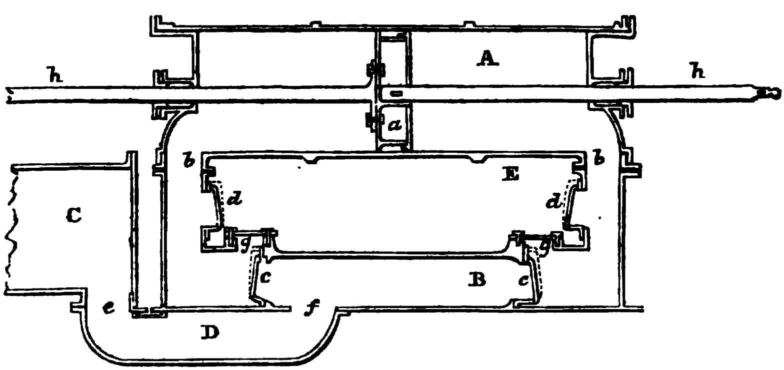
110. For improvements in *Apparatus for Drawing Liquids by Condensed Air;* Jasper Johnson, Genessee, Livingston county, New York, May 30.

This apparatus consists of a cock, and a tube which leads from said cock, down into a cellar or other place where the barrel, or vessel, containing the liquor, is deposited. Connected with this is a cylinder and piston, so arranged and combined with the cock and tube, that air may be forced down the latter by its means, until sufficiently condensed to cause the liquor to rise by the elastic force of the air. The peculiarity consists in an oblique aperture in the cock, which comes into play when the apparatus is employed for condensing, and the claim is to this part alone.

Specifications of American Patents.

Specification of a Patent for an improvement in the air pump of low pressure Steam Engines; granted to Thomas B. Silliman, *city of New York, May* 15*th*, 1837.

The nature of my invention consists in arranging a double acting horizontal air pump with its channels, passages, reservoir, and water pipes, in such a manner as to be applicable to steam boat engines, particularly those constructed upon the horizontal plan; the objects of which are to produce a more uniform effect, to lessen the concussion usually experienced in steam boats from their operation, and obtain such compactness or convenience as may arise from such arrangements.



The accompanying figure represents a longitudinal section of the apparatus; A, is the air pump; B the cylinder; C, a part of the condenser; D, channel plate, connecting the bed plate and condenser; E, reservoir; the water pipe is not seen in the section: *a* is the piston of the air pump; *b*, *b*, nozzles or openings of the same; *c*, *c*, foot valves; *d*, *d*, delivering valves; *e*, opening or nozzle of condenser; *f*, opening between channel plate D, and bed plate B; *g*, *g*, bonnets of foot valves; *h*, *h*, piston rods.

The air pump is operated by means of an upright lever, or beam, and proper connecting rods attached to the crosshead of the engine.

When in operation the water and air contained in the condenser, passes through the channel plate D, from *e* to *f*, into the bed plate B, between the two foot valves *c*, *c*, from thence through either foot valve al-

ternately into cylinder A, through the nozzles *b*, *b*; thence the water, by occupying the lowest place in the cylinder, returns first and passes into the reservoir E, through the opening of the delivery valves *d*, *d*, followed by the air and vapour which, by occupying the upper part of the cylinder, presses upon the surface of the water with an elastic force, which in addition to the gravity of the water, produces an easy delivery of the water into the reservoir, and avoiding the blow which the piston usually produces upon the water in the common arrangement.

What I claim as my invention and desire to secure by Letters Patent is, *First*, the arrangement of the channel way contained in the channel plate for the purpose of admitting the water into the bed plate between the foot valves. *Secondly*, the arrangement of the reservoir so as to receive the water from the two delivery valves attached to the opposite ends of the pump, and conduct it to the water pipe, through which it passes from the boat. *Thirdly*, the arrangement of the delivery valves and nozzles below the cylinder of the air pump, in such manner that the elasticity of the air, and gravity of the water may both conduce to the easy operation of the pump. *Fourthly*, the arrangement of the air pump of steam boats, horizontally, and in manner to allow its working a double stroke, with its combinations substantially as above described.

T. B. Silliman.

Specification of a Patent for improvements in the construction of Canal Boats; granted to Abraham Morrison, *of Johnstown, in the county of Cambria, and State of Pennsylvania, May 15th,* 1837.

To all whom it may concern: Be it known, that I, Abraham Morrison, of Johnstown, in the county of Cambria, and State of Pennsylvania, have invented a new and improved mode of constructing boats for canals, bays, lakes, and navigable rivers; and I do hereby declare that the following is a full and exact description of the same.

In giving my description I shall assume certain admeasurements, and proportion of parts, and although I shall, in so doing, give such as I believe to be well calculated to answer the purpose intended, I do not intend to limit myself in these particulars, as much latitude may be allowed in these respects whilst the principle upon which my improvements is dependent is still retained.

The form of the bottom of my boat is the reverse of that usually adopted, as, instead of being convex in the cross section, I make it concave in the cross section, from stem to stern. In building a boat of sixty feet in length, I take plank twelve feet long, thirteen inches broad, and one and a half inch thick, and these I cut to a curve of nine inches in their whole length, so that in the middle they will be only four inches wide. Of these there may be twenty-one pieces, which are to constitute the cross plank upon which the bottom and floor of my boat are to be fastened; the average distance apart of these cross pieces, when placed on edge, will be three feet. In building my boat, I first place these on edge, with the hollow side upwards, having first the side standards rabitted into, and riveted fast to the ends of the cross plank, to which the side plank are to be spiked, and so as to range properly, and then spike on the bottom sheeting of inch and a quarter plank. In arranging the cross plank and side standards, they are placed on a line for three

fourths of the length of the boat, and thence, towards the bow, they are to have such an inclination as will elevate it about twelve inches. The side plank is put on upon the ends of the cross plank, and spiked, or nailed, or screwed, to the side standards, so as to be about two inches below their lower corners, and they will consequently, project about an inch below the bottom sheeting; they are also to rise two inches above the floor, which will require plank of eighteen inches in width.

The cross plank being thus secured together, whilst this part of the boat is bottom upwards, it is then turned over, and the superstructure completed, a floor of strong inch plank is to be laid upon the cross pieces, and the side standards are to be raised, which may extend to the height of six feet above the floor, in a vertical line. The sides, top, stem, stern, and bows, may be finished in any way which may be preferred.

To give additional strength to this boat, I take two iron rods, each thirty feet in length, and three-fourths of an inch in diameter, and extend them from side to side of the boat, so as to cross each other at or near the centre, securing their ends firmly to the side plank, just below the floor. I also bolt the two sides together by means of six bars of iron, of the same size, crossing the boat about two inches below the floor.

Having thus fully described the manner in which I construct my canal boats. I hereby declare that I rest my claim to invention solely upon the form which I give to the bottom of the boat, which is concave from stem to stern, and straight, with the exception of the elevation towards the bows, as hereinbefore fully set forth.

ABRAHAM MORRISON.

Specification of a Patent for an improved Rail for Railways; granted to JOHN RUGGLES, *Thomaston, Lincoln county, Maine, May 23d*, 1837.

FIG. 1.

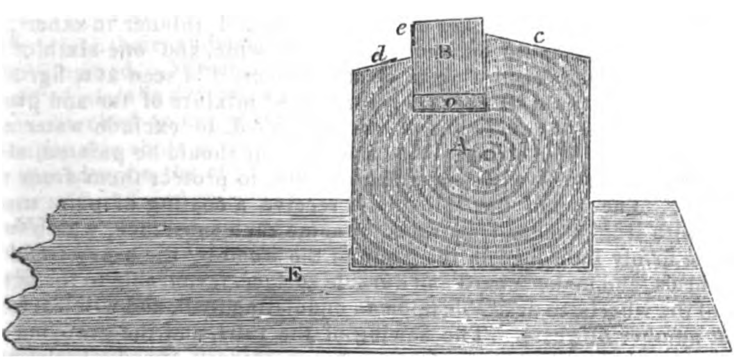
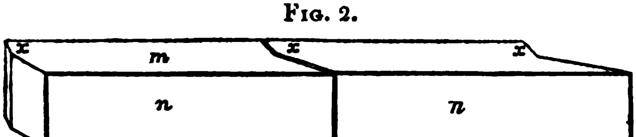


FIG. 2.



Be it known that I, John Ruggles, of Thomaston, county of Lincoln,

State of Maine, have invented a new and improved rail for railways, calculated greatly to diminish the expense of railways, increase the adhesion of the driving wheels of the locomotive engine, while it combines firmness and durability.

The following is a just description thereof; that is to say, string-pieces are laid on cross-ties, or sleepers, in the manner usual for supporting a flat-iron rail. The string-pieces may be eight inches in width by nine or ten inches in depth. Along the upper sides of the string-pieces, a tranverse section of which is seen at A, fig. 1, in the annexed drawing, is a groove three inches wide, being three inches and a half from the outside, and one inch and a half from the inside, for the insertion of a block rail B, fig. 1. The string-piece is bevilled at *c* and *d*, that water may not stand upon it; and the rail, which is three inches wide by four inches in depth, extends one inch above the string-piece on the outside, while the inside of the string-piece is reduced two inches below the top of the rail to make room for the flanches of the wheels. The block-rail is made of hard wood plank, by sawing the plank transversely to the grain of the wood, into blocks four inches in length, measuring with the grain, which being inserted into the groove side by side form a continuous rail with the grain of the wood perpendicular. The ends of the blocks where they unite in the rail should present, one of them, a convex obtuse angle, and the other a concave to correspond with it from top to bottom, to unite them more firmly, as shown at *x*, *x*, *x*, fig. 2. The blocks should be dowelled with three fourths inch dowels, and pressed firmly together by wedging or otherwise. If the string-pieces be of soft wood there should be laid at the bottom of the groove a base, of hard wood board, an inch in thickness, to prevent the rail from settling into the string-piece more in one place than another; this is seen at *o*, fig. 1.

On the inner sides of the rail there should be a plate of iron let into the rail a quarter of an inch below the top edge, and made fast with screws; it being intended as a defence of the rail against the flanch of the wheel, it may not be required except on the outside rail at curvatures; or they may be thicker at curvatures, and thinner in other places. The plate should be about one inch wide, and one-sixth of an inch thick, varying according to circumstances; it is seen at *e*, fig. 1.

The groove should be payed with a heated mixture of tar and pitch, and the seams at the insertion of the rails filled, to exclude water and prevent decay. The string-pieces and the rail should be painted, after being well seasoned, with some coarse paint to protect them from the weather. The top of the rail should receive a coating of paint made thick with iron filings, iron sand, or some such substance, which will become firmly imbedded in the grain of the wood by the heavy tread of the wheels, and make a hard and durable surface, favourable to the adhesion of the wheels, so desirable upon an undulating road, and will last for a great number of years. The sawing of the rails, and the grooving of the string-pieces may be performed by machinery expeditiously; and the adoption of block-rails, fixed as above described, will lessen the expense of railways, so as to admit of their construction in many locations which will not justify the expense of iron rails. They will be found in most cases more economical than iron rails, as well in their first construction as in their use and maintainance for any given series of years.

What I claim as my invention, is the block-rail so formed as that the tread of the wheel shall be upon the end of the grain of the wood of

which it is made, instead of upon the side of the grain; and the dowelling and confining the rail, and the top coating given to it as above described. I claim also the defending of the rail by a plate of iron, and the inserting a hard wood base for the rail to rest upon when the string-pieces are soft wood. I do not confine myself in the construction to the precise dimensions given, but claim any variation therein which the kind of timber employed, or the nature of the transportation contemplated, may justify or admit of.

JOHN RUGGLES.

Specification of a Patent for a machine for drying oil-cloths, such as are used for table covers, and granted to DANIEL SAMPSON, *Winthrop, Kennebec county, Maine, May 30th,* 1837.

Instead of extending out the cloth in length for the purpose of drying it, after it has received the paint, I wind it round a shaft, spirally, in such a way that the painted side shall be fully exposed to the action of the air whilst it is at the same time prevented from coming into contact with the contiguous coil, or with any part of the machine.

I construct two shafts, or cylinders, of sufficient length to have the painted cloth wound upon them, and mount them in a suitable frame parallel to each other. To wind the cloth on these cylinders I prepare a band of slats, which slats are united together at the ends by webbing, or by a leather or other strap of any convenient width. The slats are placed at any suitable distance apart, say one inch, and they must be of such length as to allow the cloth to lie upon them widthwise, between the connecting straps. The straps must be raised above the slats to a sufficient distance to allow a space for the cloth, which will prevent its painted surface from coming into contact with the contiguous slats, when wound. For this purpose I put between the strap and each slat, a thickness of sole leather, a small block of wood, or other suitable material.

The band of slats may be fifty or sixty feet in length, or longer if desired, and their ends are fastened respectively upon the two cylinders above named. When the painted cloth is to be operated on, the whole band of slats is first wound on one of the shafts; the end of the cloth is then attached to one of the slats, or to the shaft upon which it is to be wound; this shaft is then turned by a winch, or otherwise, as the paint is spread upon the cloth, and it is thus received and retained upon the slats and suffered to remain there until the drying is completed.

What I claim as my invention is the construction of a machine such as I have herein described, in which oil cloth is wound upon a shaft or cylinder, by the aid of a continuous band of slats, for the purpose of being dried, substantially in the manner set forth.

DANIEL SAMPSON.

Specification of a Patent for an improved mode of manufacturing Saddle Trees, of all descriptions; granted to WILLIAM KELLY, *White Deer Township, Union county, Pennsylvania, May 30th,* 1837.

To all whom it may concern, be it known, that I, William Kelly, of White Deer township, Union county, Pennsylvania, have invented an

improved mode of manufacturing saddle trees, of all descriptions; and I do hereby declare that the following is a full and exact description thereof.

My improved mode of manufacturing saddle-trees consists in the substitution of raw-hide, for the wood usually employed for that purpose, to effect which, I proceed in the following manner. After the hair has been removed from the hide, in the usual way, and the hide is properly broken, I draw, or strain it, whilst wet, either over a wooden saddle-tree, or over a mould properly shaped and prepared for that purpose, where it is to remain until it is perfectly dry and hard. Having in this way brought two, or more such pieces of hide into the proper form, I unite them together at their edges, by means of rivets, or otherwise; preferring, however, the employment of rivets to any other mode. The pieces of hide are, of course, cut to the proper size and shape for the intended purpose. I sometimes form the tree, or foundation of the saddle, of a single piece of raw-hide, in which case I turn the edges of the hide over, all round the outer and inner edges of the tree, and rivet through the double thickness. To this foundation, or tree, the irons usually employed may be fastened, as to trees of wood. Strips of spring steel, also, may be riveted on, whenever it may be deemed requisite, so as to increase the stability and elasticity of the whole: I usually affix such a spring all around the under side. After my tree, thus made, has received its proper form, and is ready for covering, I give to it a thick coating of any good water proof varnish, such as shellac, copal, or gum-elastic. In finishing the saddle any of the known modes of procedure may be adopted, according to the fancy or judgment of the workman.

All that I claim as my invention, is the forming of the trees, or foundations, for saddles, of all descriptions, from raw-hide, instead of using wood, or other material, for that purpose, as herein fully set forth.

William Kelly.

English Patents.

Improvement in Locomotive Engines.

Specification of a Patent for an improvement in Locomotive Engines, granted to Thomas Elliot Harrison, *of the county of Durham. Enrolled June 21st,* 1837.

According to the common modes of construction, in the event of the boiler, the machinery, or wheels getting out of order, and requiring repairs, the engines, boilers, and indeed the whole combined machine is obliged to be laid up and become useless, till such part is repaired; and further, in order to get at the parts so requiring repair, many joints and parts of the locomotive-engines have, in most instances, to be taken apart, and in some cases the engine is obliged to be completely stripped; which causes very considerable cost, and puts out of use many parts of the combination not wanting repair. Now according to my invention, in case of any derangement taking place in the engines and parts connected therewith, the boiler and its carriage may at once be connected with another engine-carriage; and such is the case in respect to the boiler, should it or the parts directly connected therewith get out of order, and require repair, the engine-carriage may have such boiler and its carriage disconnected, and be applied to another boiler-carriage; hence much saving will be obtained in the working of locomo-

tive-engines on railways, and fewer spare engines and boilers be required. According to my invention, the boiler of a locomotive-engine is mounted on four or more wheels, suitable for travelling on railways, and the engine or engines are mounted or carried on a separate and suitable carriage; and the various four, or more, wheeled carriages for the boilers and the carriages of the engines being capable of connection when they are to work together, and there being some spare boiler-carriages and spare engine-carriages on a line of railway, in case of a boiler or its carriage getting out of order, or in case of an engine-carriage getting out of order, it will not be necessary, as heretofore, to lay up the boiler and engines; but the one or the other will, in most instances, be capable of being used, on being connected with a fresh boiler-carriage, or engine carriage, as the case may be.

In a locomotive-engine combined and arranged according to my improvements, the boiler is mounted on a carriage with six wheels, which is a very desirable number, when the length of the boiler is such as to require support to that extent, though under other circumstances four wheels may be employed. The construction of the boiler is of that kind which is very commonly employed on the various railways now working, and is an arrangement of boiler well understood, and consequently in itself forms no part of my invention; nor do I confine myself to the use of the precise form or construction of steam boilers, as it will be evident that variations may be made. The supply-pump to the boiler may be worked by an eccentric on the axis of one of the pairs of wheels, or by any other convenient means. The two steam engines or cylinders are affixed horizontally to their carriage, which is carried, by four wheels; but I do not confine myself to the use of that number.

For conducting the steam from the boiler to the engines, and from thence to the chimney, two ball and socket-joints are used, the one attached to the boiler, the other to the engine-machinery. To make these ball and socket-joints steam-tight, they are packed after the usual mode of packing, being pressed against the ball by segments, which are firmly pressed upon the packing by screws acting upon them from the outside. It will be further necessary to have between the ball and the sockets joints, described above, a double-sliding stuffing-box, to allow for elongation. The above description refers to a means of conducting the steam from the boiler to the cylinders, and a similar arrangement will be necessary to conduct the exhausting steam from the cylinders to the chimney. The tank for containing the water to supply the boiler may be fixed upon the engine-frame, or above the framing, and a connexion formed between it and the feed pumps by a hose, as is now done between the tender and pumps of the ordinary-engines. The fuel for the supply of the engine may be carried upon the boiler-frame.

Having thus described the nature of my invention, and the manner of carrying the same into effect, I would have it understood that what I claim as my invention is the separating a locomotive-engine for railways into two carriages, one for the boiler, and the other for the engines, each carriage having four or more wheels, whereby in case of derangement of the boiler-carriage, or engine-carriage, the other may be connected with a spare or other engine-carriage or boiler-carriage, as the case may be. Great facility is thus offered for the making of repairs, or for replacing new boilers to the boiler carriages; and by this means much

saving of expense will result in the working of locomotive-engines on railways, as above described.

Repertory Pat. Inv.

Abstract of the Specification of Mr. Samuel Hall's Patent Paddle Wheel.

FIG. 1.

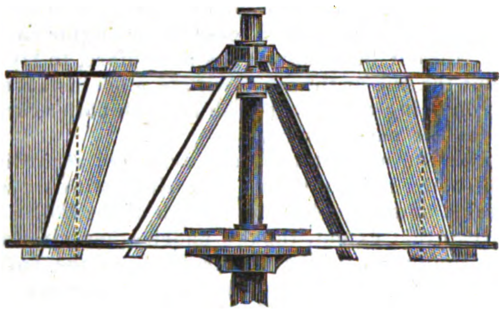
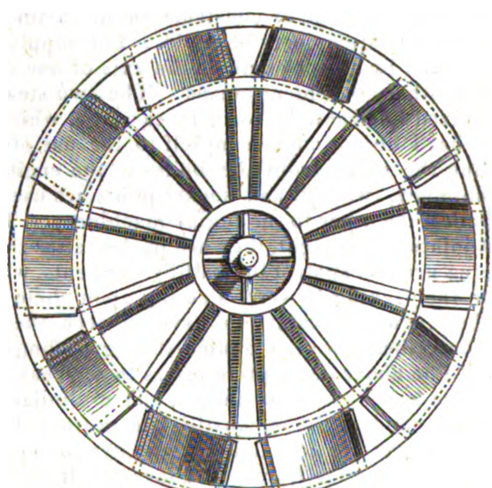


FIG. 2.



Mr. Samuel Hall, whose important improvements in steam engines have given celebrity to his name, took out a patent on the 24th of June, 1836, for "improvements in propelling vessels; also improvements in steam engines, and in the method or methods of working some parts thereof." The improvements in propelling vessels consist in the paddle wheel, of which the following is the exposition given in Mr. Hall's specification.

The object of my invention, as regards the propelling of vessels, is to reduce the tremulous motion of steam vessels and decrease the back water caused by common paddle wheels, without impairing the propelling power.

The manner in which this part of my invention is to be performed is shown at figures 1 and 2 of the annexed drawing, and consists of a mode of affixing the paddle boards to the paddle wheels, whereby during one half of the revolution of each paddle wheel the water shall be put in motion in one direction, and by the other half of the revolution the water shall be struck and put in motion in another direction, so that the paddle boards shall be constantly striking in an oblique direction against currents of water produced in different directions by the paddle boards themselves; this I effect by placing about half of the number of the paddle boards on the wheels in a diagonal position, so as not to enter the water in a line parallel with its surface, but diagonally in one direction, and by placing the other half of the number of the paddle boards so that they shall enter the water in the reverse diagonal direction, as shown by the annexed drawings. Figure 1 is a side elevation, and figure 2 an end elevation of a paddle wheel having my improvement applied; from these figures it will be seen that the paddle boards, instead of standing at right angles to the rims of the wheels and parallel to the axis of the wheel, as in wheels of the ordinary construction, are placed obliquely to the rims and to the axis of the wheel. The angle which the paddle boards should form with the axis may vary from 30° to 60°, but I prefer the mean of these two angles, viz., an angle of 45°. I have already stated, and it will be seen by the figures 1 and 2, that the paddle boards do not all incline the same way, but that half of the number incline in one direction, and the other half in the opposite direction. In large paddle wheels the oblique positions of the paddle boards may vary four times in the revolution of the paddle wheels instead of twice.

As relates to my improvements in propelling vessels, I do not lay claim to the use of paddle boards entering the water in a diagonal or feathering direction, that not being new, but I claim as my invention the making of about one half of them to enter the water in one diagonal direction, and the other half to enter it in the reverse diagonal direction, or in large paddle wheels in making the boards to change their direction of entering into the water four times during the revolution of the paddle wheels instead of twice; thus about a fourth part of the paddle boards may enter the water in one diagonal direction, the next fourth part or thereabouts may enter it in the other diagonal direction, and so on, changing their direction four times as above stated, during one revolution of the paddle wheels instead of twice. Lond. Mec. Mag.

Specification of the Patent granted to Charles Brandt, *of Upper Belgrave Place, in the County of Middlesex, Machinist, for an Improved Method of Evaporating and Cooling Fluids.*—Sealed July 27, 1836.

The nature of my said invention consists in exposing the fluid to be evaporated or cooled, on a series of extended surfaces by means of endless webs or bands, or extended surfaces connected therewith, either, or both constantly moving through the fluid and through the natural or an artificial atmosphere, as the case may be. I hereby describe the manner in which my said invention is to be performed by the following statement:—

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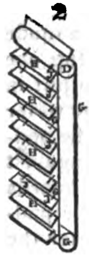

Fig. 1

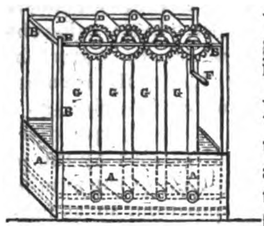

Fig. 1, is intended to represent a vat or tank of brewers' wort in progress of cooling by means of one modification of my said invention. A, A, A, A, is a vat-tank or reservoir of hot wort. B, B, B, is a frame to support the cooling apparatus. C, C, C, C, are four wooden rollers, which I call the lower rollers; and D, D, D, D, are four similar wooden rollers, which I call the upper rollers. E, E, E, E, are spur-wheels working into each other; and F, is a crank-handle fitted on to one, by turning which, motion is given to the whole. G, G, G, G, are four endless webs made of linen, hair-cloth, or other suitable substance. Now supposing the wort to be warm, but not sufficiently so to give off any perceptible vapour, if the handle F, is turned smartly round for a few revolutions, a dense steam or vapour will arise, and the temperature of the wort in the vat will be rapidly reduced. If the object be to evaporate rather than to cool, as for instance, in the process of evaporating brine in the manufacture of salt, then I make my rollers of any suitable metal or other material (dependent on the nature of the fluid to be evaporated,) and hollow, and introduce hot steam through both the upper and lower rollers, in order to heat the fluid in one case, and to drive it off in vapour from the web in the other, and in such cases I add to the endless web or band, leaves, or what I call surface-boards, or drip-leaves, as shewn in fig. 2, which represents one upper and one lower roller only of the apparatus, which will, when complete, be composed as before of a series of several. G, G, is the endless web as before. And the parts, similar to that marked H, are thin leaves of wood or metal, or other suitable material, sewed, laced, or otherwise hinged on to the web, and furnished with check-strings, as at J, J, J, by which a proper angle is preserved, as here shewn. As these leaves, which I call drip-leaves, are carried round by the web, a very extensive surface of the fluid is exposed for evaporation, which the constant dripping from the drip-leaves greatly promotes, and if the operation be performed in an artificially heated atmosphere, the result will be very rapid evaporation.

Repert. Pat. Inv.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the Smelting of Iron with Anthracite Coal. By G. Crane.

On Monday, the first day of the meeting, the following communication "On the Smelting of Iron with Anthracite Coal" was made by Mr. George Crane, of the Yniscedwin Iron Works, to the Chemical Section of the British Association.

The great extent of the deposit of that description of fuel called anthracite, or stone coal, in the Mineral Basin of South Wales, accompanied, as it is, with iron mine in great abundance, and of good quality, has long made it an object of great interest to parties connected with that district, to discover some method of applying that description of coal to smelting purposes. One of the earliest patents enrolled in this country for this object, was that of

Mr. Martin, in 1804. From the mode detailed in his specification, there does not appear to have been any peculiarity in his process; he evidently expected to have succeeded in using this fuel by the only mode of blowing a furnace then known, that by cold blast. Another patent was taken out about twenty years afterwards, for a mode of forming a conglomerate coke, composed partly of the small of the anthracite veins, locally called culm, with a sufficient portion of the small of the bituminous, or binding veins, to cement the whole, when coked in an oven together; had this latter plan been attended with success, its application would of course have been limited to those localities where the two descriptions of coal were to be found near each other.

The Yniscedwin Iron Works, which are in my possession, are placed upon the anthracite formation. Until I discovered the method of applying this particular description of fuel to the smelting of iron ore, I was obliged to avail myself of the coal of the bituminous veins, obtained from the adjoining parish of Rillybebill, for the supply of the blast furnaces at Yniscedwin. During the fourteen years in which I have been engaged in the iron trade of South Wales, I have had my attention anxiously directed to the application of anthracite coal to smelting purposes, and at different periods, at a large outlay, tried a variety of plans, but without success, until the idea occurred to me that a hot, or heated blast, upon the principle of Mr. Neilson's patent, might, by its greater power, enable me to complete the combustion of this peculiar coal. I have now the pleasure of reporting to this meeting, that I have completely succeeded in the application of anthracite to the smelting of ironstone and ore.

That I have used no other fuel in a cupola blast furnace since the 7th of February last, and that the success of the experiment in the combination of hot, or heated air, with the coal in question, as fully detailed in the specification of my patent of improvement, enrolled in March last, has been in every respect of so satisfactory a description, whether with regard to the quantity of the iron produced, the quality of such iron, and the economy of the process, that I am now, and have been for the last three months, actively engaged in making the necessary preparations for the introduction of anthracite coal, instead of the coke of the bituminous veins, upon the whole of the blast furnaces which I at present have (three in number) at the Yniscedwin Iron Works: that I have renewed all my mineral takings in the anthracite part of the basin for ninety-nine years, and that I have arrangements in contemplation for a large extension of the works, in consequence of the perfect success which has resulted from the experiment.

One of the three furnaces at present on my establishment, is a small cupola furnace, which we call No. 2, built from the top of the hearth with firebricks only; this cupola is of the following dimensions:—Forty-one feet in its whole height; ten feet and a half across the boshes, and the walls of the thickness of two nine-inch bricks; the hearth three feet six inches square, and five feet deep. The two other furnaces, which we call No. 1 and No. 3, are thick stone-walled furnaces. Some years since I found that this cupola furnace, No. 2 had, on the average of a long period (I concluded from the smallness of its dimensions and the thickness of its walls,) taken so large an excess of minerals to the ton of iron produced, when compared with the quantity taken on the average of the same period by the stone-walled furnace, No. 1, standing within fifty feet of it, that I determined to erect a second furnace, similar to the latter one, in lieu of it.

The meeting will shortly understand why I am giving these details, which

may at the moment appear not to be very interesting particulars. This cupola furnace, No. 2, not being at work when I arrived at the determination to try the experiment of the combination of the hot blast and anthracite coal upon the large scale, it was more convenient to put this furnace into blast for the purpose, rather than to interfere with the usual progress of my business by experimentalizing in either of the two other furnaces. The cupola furnace, No. 2, from the causes which I have before explained, had on the average of a long period taken cokes, the produce of five tons and three cwt. of coal to the ton of pig iron, when the stone walled furnaces had not required cokes to the ton of metal produced, quite equal to four tons of coal. The consumption of ironstone and limestone had been greater in the former than in the latter description of furnace, but not to so great an extent.

I will make one other explanatory remark on this part of the subject. The two descriptions of furnaces have worked in so different a manner with the minerals of my neighbourhood, that whilst the barrow of cokes, weighing about three and a half cwt., would take, when consumed in either of the stone-walled furnaces, a charge or burden of five to five and a half cwt. of calcined iron mine, of the descriptions obtained in my neighbourhood, according to the kind of iron which I was desirous of producing, the same barrow of cokes in the No. 2 cupola, or thin-walled furnace would only carry from three to three and a half cwt. of calcined mine of the same kind. Under these disadvantageous circumstances, I have actually produced from the No. 2 cupola furnace the ton of iron in the smelting process, on the average of three months, with less than twenty-seven cwt. of anthracite coal. The heating of the blast, and the calcination of the mine require, of course, upon my plan, the same quantity of fuel, which is necessary for the like processes in other establishments.

With regard to the quantity of iron produced, the result which I have to report is equally satisfactory. I must not, however, omit to mention that for the greater convenience of filling this cupola furnace, No. 2, from an adjacent gallery, previous to the commencement of my anthracite experiments, I raised it in height from thirty-six feet six inches to forty-one feet; this might have had *some* effect upon reducing the excess of the consumption of fuel when compared with that which had taken place in the No. 1, and might have increased its power of smelting with my blast of one quarter pound upon the square inch pressure, only from its former average of twenty-two tons to twenty-four. Since I have adopted the use of anthracite coal combined with hot air, my make in the No. 2 cupola furnace, with the same pressure of blast only, has ranged from thirty to thirty-four and thirty-six tons, and one week we actually tapped within three cwt. of thirty-nine tons of grey iron from this furnace; its present weekly average may be expected to range from thirty-five to thirty-six tons.

With respect to the quality of the iron produced by the combination of hot blast and anthracite coal, the result which I have to communicate will be very satisfactory; it is well known in my neighbourhood that my cold blast iron for all purposes, where great strength was required, was never deemed inferior to any smelted in South Wales; that which I have hitherto produced with hot blast and anthracite coal is, however, decidedly stronger than any other before smelted at the Yniscedwin Iron Works.

Relying upon the representations of chemists, that anthracite coal is almost entirely composed of pure carbon, I have always indulged the hope, that in the event of my ever succeeding in discovering a method of apply-

ing this fuel to smelting purposes, that I should be able to produce a quality of iron not very dissimilar to that formerly obtained by smelting with charcoal; how far this expectation will be realized further experience must prove; but, as far as my experience of the quality of this particular description of iron up to the present time has gone, I am sanguine with respect to the result. I shall be happy at any time to offer every facility in my power to any parties who may be deputed by this Association, or by any other scientific body, to thoroughly investigate this important subject.

If I have not trespassed already too long upon the time of the Section, its members may not be uninterested in being informed in what manner the idea first occurred to me of applying an heated blast to anthracite coal. One evening after I had placed a piece of it upon my parlour fire (which had before been made up with bituminous coal,) and had allowed it to arrive at a red heat, upon my applying as fierce a blast to this piece of coal as I could raise from a pair of bellows, I noticed the appearance of a black mark or spot upon that part of it where the air impinged upon it; on my continuing the like rapid current, in the same direction, I shortly blew the fire out of it. I at once perceived that the effect of the strength of the current of air, when cold, which we of necessity are obliged to blow into our furnaces to secure the passage of the blast through the high and dense column of materials contained in an erection like a blast furnace, instead of encouraging ignition, was actually unfavourable to it. On giving the thing but a moment's reflection, the question promptly occurred to me, What would be the effect of turning a blast into a furnace upon this coal, which would itself burn—which would itself melt lead? I at once determined that it was a thought which was really worthy mature reflection. The further consideration which I gave to the matter, and the further experiments which I shortly afterwards instituted, (which were continued at a great expense for some months,) have at length been crowned with the full success which I have now had the pleasure of reporting to this meeting.

The anthracite formation probably occupies about one third of the Mineral Basin of South Wales; it commences near the upper part of the vale of Neath, in the county of Glamorgan, and proceeds in a westwardly direction through the remainder of that county, thence through that of Carmarthen, and crops out, (as I am informed,) in the sea, in St. Budes Bay, after passing through a considerable portion of the county of Pembroke. It is likewise to be found in France, Austria, Bohemia, and Sardinia, in the Old World; and very large deposites of it have been already discovered on the continent of America, particularly in the state of Pennsylvania.

Proceedings of the British Association.—Mining Journal.

Improbability of explosions in Steam Boilers by the generation of Hydrogen Gas.

Although the question of the production of hydrogen in a steam boiler when suddenly replenished with water while the metal is in a state of incandescence, and consequent explosion from a mixture of the inflamable gas with atmospheric air was treated with sufficient clearness by the committee of the Franklin Institute, as may be seen by a reference to the report, (Jour. Frank. Inst. Vol. XVII, p. 217.) Yet as danger from such a source has been much insisted upon and may still be apprehended by some who have not taken the trouble to read that report, it may not be unadvisable to introduce the opinion of an able engineer, given in testimony before the proper authorities at Hull, in consequence

of the disastrous explosion of the Union Steam Packet, at that place. Not knowing at what period precisely, this evidence was taken, we cannot judge of the possibility of the witness having seen the report of the Franklin Institute. His opinions coincide with the conclusions of the committee, and in reference to the results thus experimentally obtained, we may adopt the words of a writer in the London Mechanics Magazine, June 17th, 1837;—"in fact, the report altogether ought to be studied by every one having the responsibility of the direction of a steam engine, and human life in his care."

A verdict of manslaughter was rendered by the jury, against the engineer, in the case above referred to. G.

*Mr. T. J. Pearsall** stated—"I have considered the subject of the explosion of the boiler of the Union. In my opinion it could not have taken place had the boiler been sufficiently supplied with water, unless the steam generated was prevented escaping by some very great force, which should hold the safety-valve fastened down or obstructed. I consider the immediate cause of the bursting of the boiler to have been the expansive power of steam, because steam is capable of producing any such effects. I am most decidedly of opinion that it did not arise from gas. My reasons for that opinion are that although water is decomposed readily by red-hot iron, yet it requires that the surface of the iron should be in a metallic state; a new boiler is nearly in that condition, but not quite so; there is just the chance that if a new boiler were employed, and very pure water admitted in small quantity, so as to allow portions of the boiler to become red-hot, then water might become decomposed; but such circumstances would at the same time be sufficient to generate an incalculable amount of steam. Such explosion, therefore, would arise from mixed causes—such as the presence of the gas, and the enormous amount of steam, and its great pressure. I cannot suppose a case where such decomposition of water and evolution of gas would take place, where such water is employed as that of the Humber, or as that furnished by the Ocean. Such gas would not be inflammable of itself,—there must be the presence of atmospheric air or oxygen, and of flame, or a substance heated to a very high degree.

"I can scarcely imagine such an explosion in a boiler, because there must be also a mixture of oxygen with hydrogen in proper proportion. I cannot conceive in what manner atmospheric air could gain admission to the boiler the pressure of the gas from within being greater than that of the air from without, and the aperture which would admit the atmospheric air would allow the escape of the hydrogen. Hydrogen gas would operate upon the safety-valve in the same manner as steam. *I know not one single instance of one particle of evidence of the presence of hydrogen in a boiler.*

"When a boiler has been at work some time, and becomes incrusted with saline and other earthy matter, it is quite contrary to all known chemical principles, to suppose that water can be decomposed by such earthy substances; it is quite hypothetical to suppose that it can be so decomposed. I do not know that under any circumstances water could be resolved into its two elements—hydrogen and oxygen—by heat alone. In all cases the quantity of hydrogen generated must be very limited compared with the

*This gentleman was a pupil of Prof. Faraday,—was several years the assistant, in the Royal Institution, of that eminent investigator, and has recently retired from the Professorship of Chemistry in the Medical School at Hull, to direct the manufactures on a large scale, which eminently depend upon that science.

amount of steam formed by the high temperature. I would say that if hydrogen were in the boiler, and oxygen were to gain access, the hydrogen would escape by the same means as the oxygen entered; the pressure of all gases is the same when generated, and it is impossible to conceive that hydrogen should have less pressure than that of atmospheric air at the same temperature. It would require a very large portion of the oxygen of the atmosphere to be in contact with the hydrogen in the boiler to cause an explosion. In 100 parts of atmospheric air there are only about 20 of oxygen, and it is that alone which is required to explode the hydrogen, the nitrogen of the atmosphere having only the effect of diluting it. A possible introduction of air into a steam-boiler may be that of the air contained in the water itself, which may be evolved when the water is boiled, but this quantity of atmospheric air is very small, about four per cent. of the bulk of the fluid water, and not so much air as that can be obtained from sea water. In round numbers one cubic inch of water will afford 1700 cubic inches of steam, which, decomposed at that temperature, expands into thrice its volume of gases, two-thirds being hydrogen gas, requiring about 17,000 cubic inches of atmospheric air for full and rapid combustion, while the original cubic inch of water only gave off one-twenty fifth of its bulk of air.

"If safety-valves be of the proper size, and steam be raised gradually, the valve will operate; but if you raise an enormous amount of steam at once, or under extraordinary circumstances, and wish it to be at once discharged, such circumstances, as when you have too little water, and portions of the boiler be red-hot, and by a motion of the vessel any sudden evolution of steam is caused, then the valve will be rendered comparatively useless or dangerous. I consider steam capable of producing an explosion such as this. I know of no greater explosive power than steam, except gunpowder. Perkin's patent gun, in the Adelaide Gallery, daily throws off a number of balls per minute by steam; and if gas be produced by means similar to those alluded to, it must be produced in the instance of Perkins's gun; had the explosion been caused by gas, it must have been accompanied by a very vivid flash."

Mag. Pop. Sci.

Advantages of Anthracite coal in the Hot Blast Furnace.

At a meeting of the Royal Cornwall Polytechnic Society on Wednesday, Oct. 11, Mr. R. W. Fox stated that he had received that morning, a paper from a relative of his in Wales, Joseph T. Price, Esq., from which the following are extracts:

"Our experiment at Neath Abbey has shown that, by combining a portion of bituminous coal, coked in ovens with a portion of anthracite, 20 cwt. of cast iron may be made by 33 cwt., ¾ths of the former, ¼th of the latter.—The iron made by using the hot blast is generally more tender, more lead-like, and more easily broken, than when coke or bituminous coal only is employed. By the use of the anthracite in the proportion stated, and also without any mixture of bituminous coal, it is materially stronger, and I should say better, and really more valuable as a marketable article, and for the uses to which it is applicable.—Our experiments are only commenced, I am, therefore, not prepared to state more than very general results.—When complete success had attended the use of the quarter part anthracite with three-quarters part of bituminous coke, we put on the furnace half of each. The result was that the change checked the make of iron one-half nearly—40 charges of iron-stone, coal, and coke, in twelve

hours were reduced to 20 by it, and consequently the yield of iron proportionately. However, we quickly returned to the quarter anthracite, and three-quarters coke." The letter went on to state that the advantages already obtained were a diminished consumption of fuel, and an improved quality of iron. The precise degree of improvement could only be generally stated at present.

Mr. Price proceeds to say—"I transmit a specimen of anthracite iron, made at Neath Abbay; I call it anthracite iron, because it was enriched and its nature strengthened, by a mixture of about a quarter part of anthracite, or stone coal with three parts of coke, made in ovens from bituminous coal. — Before I close, permit me to offer through your society, a premium of ten guineas, for the best experiments, on the strength and tenacity of Anthracite Cast Iron, 1st and 2nd fusion, distinguishing the proportion of each kind of coal used, as compared with the strength and tenacity of Welsh, Scotch, and English cast iron of parallel qualities, 1st and 2d fusion, made with ordinary coal or coke, to be accompanied by a well-attested statement of the proportion of coal, anthracite, or stone-coal, and of the kinds of mine-ore and flux, used in the manufacture of each."

Mr. Fox then stated an interesting fact, mentioned to him by a gentleman from the Brazils, who had been engaged extensively in mining; that the veins there, as here, run north and south, exemplifying the magnetic power and the magnetic meridian. He said it might be remembered that he last year exhibited some specimens of copper ore, which had been altered by long-continued electrical action. He now produced some specimens of clay, in which veins and insulated portions of copper had been formed by the same agency. They were formed in masses of clay separating the copper ore from the zinc in the manner which he had heretofore described, and in which the electric action had long continued. He had also to lay before the meeting some clay which by means of the same agency had assumed the laminated appearance of clay slate. (These specimens were then produced to the meeting.) Mr. Fox proceeded to say that it was not a little gratifying to him to present to the society such strong evidence in favour of those views; and which appeared to him to be no longer questionable, at least as regarded the *laminæ* of clay-slate, and other rocks of a corresponding structure; and he thought it not improbable, that similar evidence might ere long be obtained, that the symmetical joints of rocks are due to similar agency.—Thus it appeared, he said, that the structure of rocks had a direct tendency to confirm the theory which he had endeavoured to put forth relative to the formation of mineral veins: and the facts which from time to time had come under his notice, had tended more and more to satisfy him of the influencial agency of electricity in their production. Indeed, he believed, that the structural and relative characters and qualities of coal-beds were also connected with chemical action.—Several other gentlemen then addressed the meeting, and some premiums announced for the next year.—Subscriptions were entered into to enable the society to build a gallery.

But one feeling prevailed on the occasion of this meeting, and that was one of high gratification at witnessing the important benefits which this society has already conferred on this county in particular, and on the country in general. The committee and every person connected with its management deserve the warmest approbation.

Lond. Mec. Mag.

Mica as a Substitute for Glass.

This beautiful substance, which may be termed elastic glass, is capable of being appropriated to many useful purposes, to which it has not been hitherto applied, except by one or two individuals. One reason for the apparent neglect of this most beautiful and unique mineral may have been its scarcity in this country. We have frequently purchased it at the rate of twenty and twenty-five shillings a pound, whereas it may be imported at one third the sum. We believe that a considerable portion of the mica imported into England is required for a new kind of stove, which we, however, have never seen in operation. It is used also in the construction of cards of magnetic compasses, as it has the peculiar property of always preserving its plane, so that when pasted to the under surface of the card, it prevents it from warping.

Several years ago we applied mica to a new and very useful purpose, for which it is particularly adapted, and we should have publicly recommended its adoption, had not gas lights almost entirely superseded the Argand Lamp. As glasses, however, are often used with gas burners, we take the opportunity of stating, that in order to convert the mica to this purpose, it should be split as thin as possible, and then bent round into a cylinder, the edges lapping over each other a little, and secured by a thin slip of brass rivetted to the mica. It is infinitely preferable to glass for this purpose, as it is neither liable to break nor to be burnt.

There is another most important use for which mica is peculiarly adapted, although we have never heard of its having been so applied. We advert to its substitution for glass in hot houses, as the substance, from its elasticity, would endure the most tremendous hail storms, which are often known to destroy hundreds and thousands of glass panes. Mica has long been used as a substitute for horn in lanterns, and the application is judicious, as independent of its superior transparency, it is not liable to be destroyed or even affected by contact with the flame, which would blister and destroy horn. We are not aware that mica has ever been used for the slides of the magic lantern, but it is preferable to glass, because independent of its elasticity, it admits of having the figure drawn and colored with more facility than glass.

We have also succeeded in silvering mica, so as to form very perfect and elastic mirrors, which may be carried in a pocket-book.

Having occasion for a cylindrical mirror, for that beautiful optical instrument for restoring distorted images to regular figure, we found mica particularly adapted for our purpose, from the facility with which, after being silvered, it could be bent into a cylindrical form. We believe no name has been assigned to this elegant instrument, which has, however, been fully described in "Hooper's Rational Recreations," and in Priestley's large "Treatise on Vision, Light, and Colours," amongst the plates of which it is numbered 53.

We have tried some experiments with the mica, as a surface upon which to work with the graver or the etching tool, and we have long thought that it might be advantageously used in the lithographic process. If our conjecture should be well founded, it would be extremely acceptable to travelling artists, as they might make their sketches on the spot upon the leaves of mica, and afterwards pass them through the press. We have now before us a small copy of a well known picture of Wilke, printed in lithography, from a surface of mica, and we shall leave it at

our office for the inspection of any scientific gentlemen who may wish to examine it.

A few days ago we met some very fine specimens of water colours upon mica, executed at Patna, in Hindostan; and as this use of the substance is probably new to the scientific gentlemen now in Liverpool, we have prevailed upon the gentleman who has the specimens, to leave some of them with Messrs. Wordley and Mayer, silversmiths, in Lord street, for the inspection of the curious. One of these specimens, representing Indian costumes, may also be seen in the window of our office. If the surface is suitable for oil painting, it would open quite a new field to our artists, especially our miniature painters, as the picture would at one process be painted and glazed. Mining Journal.

New Sand for Glass making.

The silver medal of the Society of Arts was awarded for the discovery of a sand in the colony of New South Wales, eminently fitted for the manufacture of the finer kinds of glass.—The following notes on the subject are interesting:—In the year 1831 it was observed, that in many places between Sydney and Botany Bay the surface of the ground was covered by a remarkably pure and white siliceous sand, derived from the decomposition of one of the beds of sand belonging to the coal formation. Mr. King, of Sydney, the discoverer, being of opinion that this sand would be found peculiarly applicable to the business of glass-makers, forwarded eleven bags of the same to his agents, Messrs. Buckle, Baxter, and Buckle of London. These arrived in June, 1832, and some was put into the hands of Messrs. Pellatt and Co., of the Falcon Glass-house, for trial. In August of the same year they reported the result of their experiments. From their report the following is an extract:—"We find the sand from Sydney to be decidedly superior to any we have previously employed. The most esteemed property of this sand, and that which makes it of the greatest importance to glass-makers, is derived from the absence of oxide of iron and every other combination that would affect the colour of the glass when made. It is also free from insoluble matter. Glass made from this sand is more brilliant and watery than any other. We consider it fortunate at this period that this sand has been discovered, as the sand with which most glass-makers were supplied is now of very bad quality, and has been given up by many." According to an analysis of a sample of this sand, made conjointly with Mr. Children, of the British Museum, and Mr. Garden, it appears to consist of 95.0 silica, 2.2 sulphate of lime, 0.4 oxide of iron, with a trace of alumine—making 97.6; leaving 2.4 for organic matter, water, and loss, the whole will be 100.0. On application to Mr. Pellatt the following further particulars were obtained:—He says that the recent arrival of a few hundred weight of this superior silex had enabled him to make a second experiment, which turned out fully as well as the first. He is of opinion that the Sydney sand exceeds all others heretofore in use, for whiteness, brilliancy, and fusibility; and he has little doubt, should the freight be moderate, that this comparatively pure material will be imported in large quantities for glass-makers' use in this country. He had mixed it with the usual proportions of carbonate of potash and nitrate of potash, with a rather less proportion of manganese than other sands require. Mr. Pellatt adds, that he hopes soon to be able to report on the Sydney sand as regards flint glass-

ware for optic plates. A few tons of the same kind of sand were lately imported into Liverpool, and were eagerly purchased, so that a considerable improvement in the qualities of the finer kinds of flint glass may soon be expected. Ibid.

On the action of Cold Air in maintaining heat. BY ROBERT ADDAMS, *Esq.*

I was at Sheffield in last December, and then a Mr. Linley, bellows-maker of that town, showed me the following curious experiments: first, a rod of iron, about an inch in diameter, was heated at one end in a forge fire, up to a full white heat, then quickly withdrawn from the fire and exposed to a strong blast of cold air from a forge bellows; the iron immediately became so hot as to fuse, and the liquefied matter was blown off and burnt in the air with the scintillating appearance of iron wire burning in oxygen gas; and so continued to melt until a pound or more of the metal had been thus wasted.

Another mode of producing the same action consisted in heating a rod of iron, as before; but instead of a blast of air, it was tied to a cord, and by it whirled round in a vertical plane; thus by passing swiftly through the cold air it melted, and was thrown off in beautiful scintillations, appearing as luminous tangents to the circle in which the bar was moved.

I have since applied a heated bar of iron to the periphery of a revolving wheel, and by an including tin hoop or guard, it is thus made an interesting class experiment.

The cause of this augmentation of temperature is, I conceive, referable to the oxidation of the metal, which takes place freely under the conditions of the experiments here recorded. Then, as is well known, the formation of the oxide is accompanied with a great development of heat; and the cases before us are striking examples of the heating influence by chemical action predominating over the cooling effect of the air conjoined with the radiating force.

The success of these experiments chiefly depends upon having the iron at first of a sufficiently high temperature, and upon the velocity of the air from the bellows, or otherwise the velocity of the iron through the air. For the iron at a white heat is greedy of oxygen, which the air solidifies. Then the oxide thus formed requires to be blown or whirled off, in order that fresh surfaces of the *metal* may be exposed to the air.

When the blast is employed, we see the oxide fusing, and deep channels scooped out in the bar by the rushing air on that side where the current is directed. Lond. and Edin. Philos. Mag.

Iron Steam Vessels.

The Rainbow, an iron steam vessel, built for the General Steam Navigation Company, has been launched since our last, from Mr. J. Laird's yard, at Birkenhead, near Liverpool. She is the largest iron steam vessel built or building in this country, her dimensions being, length over all, 213 feet; beam, within paddle-boxes, 25 feet; extreme width, 49. She is divided into six compartments, by five water-tight partitions, which entirely remove all danger of sinking in case of collision with other vessels; and if all the other advantages iron vessels possess are left out of view, the simple fact, that in them these partitions can be rendered most efficient and secure, will, we

have no doubt, cause their general adoption, both for sea-going and river vessels. The Rainbow is now being fitted by Messrs. Forrester and Co., with a pair of ninety horse power engines; and her cabins, which are of the most spacious and elegant description, are also in a forward state. The Rainbow is the tenth vessel built by Mr. Laird, with water-tight compartments, and we understand that he has now three other large ones building on the same principle. We are induced more particularly to notice the launch of this vessel, as an iron steam boat, called the Sirius, lately launched at the Isle of Dogs, is wrongly stated in the *Railway Magazine* to be the longest yet made of iron. She measures only 164 feet in keel, and 176 on deck, with a beam of 17 feet. She will have two high-pressure engines of thirty-five horse power each, with twenty-four inch cylinders of three and a half feet stroke, and three boilers with copper tubes worked expansively. She is divided into four compartments, by three iron water-tight bulkheads similar to those of the Rainbow; but it will be seen, on comparing the dimensions we have given, that she will not bear a comparison with her northern rival. It is confidently expected that the Rainbow, from her superior model and light draft of water, will be one of the fastest vessels afloat. The Sirius is intended for the Rhone, and it is no difficult matter to see that these iron steamers are gradually becoming general.

Nautical Magazine.

Progress of Physical Science.

British Association, September 12.—*Vegetable Physiology.*

Mr. Bowman read a paper from Mr. Gardner, "On the internal structure of the wood of Palms." The attention of Mr. Gardner, who is residing in Brazil, was directed to this subject by the remarks made by Professor Lindley, in his "Introduction to Botany." In order to test the truth of the theory of Mohl, he made several experiments on the palms in his district. He made a vertical section of a palm, four inches in circumference, and, by doing this, he could trace very plainly woody fibres proceeding from the base of the leaves to the centre of the stem, at an angle of 18 degrees; they then turned downwards and outwards to within a few lines of the external cortical part of the stem, running parallel with its axis. The distance between these two points was about two feet and à half. The fibres were traced quite distinctly up into the centre of the leaf. In answer to the questions proposed by Lindley in his work, the author stated:—1. That the wood of palms was always hard and compact outside, gradually getting softer towards the centre, the fibres of the upper leaves not descending to so great a depth as the lower. 2. The wood is much harder at the bottom than any other part of the stem, the inhabitants of tropical climates using only this part for economical purposes.

Professor Lindley observed, that this paper confirmed the views of the structure both of endogens and exogens, which had been increasingly embraced by botanists. In the first place, the views of Mohl on the structure of endogens were confirmed. There was, however, a slight difference between Mr. Gardner and Professor Mohl; the latter having stated that the woody fibres of endogens terminated *in* their cortical integument, whilst the former had traced them only within a few lines of this point. In the next place, the paper confirmed the theory of the for-

mation of wood from the emanation of fibres from the leaves. Whatever might be the difference between the arrangement of the fibres of exogens and endogens, there could be no doubt that their origin was the same. Mr. Gardner had referred, in his paper, to the glandular disks on the woody fibre that were, at one time, thought to characterize the order Coniferæ. He would, however, draw the attention of the section to a fact that had lately been discovered, and not hitherto published, that these glandular disks existed on all the woody fibres of plants that yielded resinous matter. Brown first discovered them in the wood of Tasmania, (*Winteraceæ,*) and Griffiths had since demonstrated them in Spherostema, (*Schizandreæ.*)

Mr. Nevin detailed some experiments on vegetable physiology. The experiments were performed on elms forty years of age, in February, 1836.

1. The stem of the tree was denuded, in a circle, of its cortical integument alone, leaving the alburnum beneath uninjured. On the May following the denuded part was filled up by the exudation of bark and wood from the upper surface of the wound, and the tree had not suffered in growth.

2. The bark and *cambium* were removed in the same manner. In August 1837 this tree sickened, and there was no formation of wood or bark in the wounded part. Two developments, however, took place one above the other, from below; the former having the appearance of roots, the latter were branches with leaves.

3. The bark and two layers of alburnum were cut away. The tree was at the time unhealthy; it however put forth its leaves on that and the ensuing spring, but shortly after died. No sap was observed above or below the wounded part. Roots were developed from the upper, and branches from the lower part of the section.

4. The bark and six layers of alburnum were taken off. The tree became much less vigorous, but did not die, and otherwise presented the same appearance as the last.

5. The bark and twelve layers of alburnum were stripped. The consequences were again similar to the last two; the alburnum above and below the cut being dry, but an accidental cut that penetrated into the heart wood exuded sap.

6. This was a repetition of the experiment of Palisot de Beauvais, by cutting away a circular ring of bark around a single branch. The branch continued to grow, and roots sprouted from the under surface of the isolated bark and branch.

7. In this the whole of the wood of the tree was cut away, except four pillars, composed of bark and sap wood. In this case, the sap first appeared from above, descending by the pith, and then from the heart wood, the alburnum being dry. In this case the sap must have passed up the alburnum, and horizontally through to the heart wood.

Mr Nevin inferred from these experiments—1. That the life of the tree does not depend on the liber or cambium. 2. A descent of sap takes place before the development of leaves. 3. That new matter arises from below: which had not previously been allowed. He thought there were two distinct principles in the tree,—one, the ascending or leaf principle: the other, the descending or root principle. Mr. Nevin had also performed some experiments on the conversion of roots into branches, and came to the conclusion, that buds or branches might be

developed from any part of the root above its extreme end, from which point it was impossible for buds to be developed.

Professor Lindley remarked that these experiments confirmed entirely the theory of the structure of wood adopted by Du Petit Thouars. He did not think that the existence of any new principle could be inferred from the experiments. In the seventh experiment the horizontal circulation of the sap was proved, and confirmed the accuracy of Hall's experiment of cutting a tree nearly through on alternate sides, when the sap still ascended. Lon. & Ed. Philos. Mag.

Artificial Production of Rubies.

A few months since M. Guadin presented to the Academy of Sciences of Paris a note, in which he announced his having been able to produce rubies in considerable quantities by a process of which he has given merely a sketch.

In order to obtain these substances analogous to rubies, M. Gaudin uses a platinum blowpipe of a single piece, formed of two hollow concentric cylinders, communicating by one of the extremities, one with a reservoir of hydrogen, the other with a reservoir of oxygen; the two other extremities are pierced with convergent openings, so as to effect in a great degree the mixture of the gases.

It is well known that alumina is fusible with the oxygen and hydrogen blowpipe; but no one before M. Gaudin had endeavored to melt this earth into globules several millimetres in size. Having submitted a piece of potash alum to the action of his blowpipe, he obtained a perfectly round and limpid globule. The platinum tube being perforated and melted at several places, he obtained after the cooling, instead of a limpid spheroid, an opake elongated globule, and covered internally with crystals, which may be referred to the cube or to the rhombohedron. These crystals scratch rock crystal, topaz, garnet, and spinelle; with regard to hardness, therefore, they agree with the ordinary ruby. They appear to be composed solely of alumina, the potash votalizing at the high temperature to which the alum is submitted.

Having obtained an apparatus stronger than the one first used, he made an experiment with some ammoniacal alum mixed with from 4 to 5 thousandths of chromate of potash; the whole being previously calcined, he gave it the form of a spherical cup, in order to obtain a maximum effect, by directing the flame to the concave part. In a few moments the inner surface of this cup was covered with globules of a beautiful ruby red colour, slightly translucid, and some of which exhibited the form and cleavage of the ruby.

M. Malaguti, who had occasion to analyse these globules, found them to be composed of 97 parts alumina, one of oxide of chrome, and two parts of silica and lime; which composition is analogous to that of the ruby. Comptes Rendus, August, 1837, p. 325. Ibid.

A New Organic Acid.

M. Peligot has read to the Academy of Sciences some observations on cane sugar, and on a new acid derived from the action of alkalies on sugar of starch.

It is well known that there exist two distinct varieties of sugar; one

of them is common sugar, extracted from the cane, beet root, and the maple; the other occurs in grapes and diabetic urine, and is formed when starch, lignin, or sugar of milk is treated with dilute sulphuric acid. It is also known that, influenced by various circumstances, common sugar may be converted into sugar identical with that of starch.

Among the differences which exist between the two kinds of sugar, one of the most prominent, (says M. Peligot,) is in my opinion that which is observed when these bodies are put in contact with alkaline bases.

Common sugar, when added to potash, lime, or barytes, combines with these bases, and acts towards them the part of a true acid*: by boiling a mixed solution of barytes and sugar, I obtained by direct action a crystallized compound of these two bodies; the analysis of saccharate of barytes, and other analogous salts, proves that the sugar does not undergo any particular modification: on decomposing the saccharates by weak acids, the sugar re-appears with its usual properties.

The case is entirely different with sugar of starch; the alkalies effect an essential alteration in it. On putting lime or barytes into a solution of this sugar, even cold, I observed that after a certain time these bases had lost their alkaline properties, and were saturated with a new and very powerful acid, which is formed by simple contact with the sugar, and which immediately unites with the alkalies, and forms perfectly neutral salts. This acid may be still more readily obtained by putting dry sugar of starch, fused at 212°, in contact with crystallized hydrate of barytes. Vivid re-action takes place almost immediately; the mixture swells, the temperature rises very much, and in a few seconds the sugar is transformed into acid. The barytic salt is then dissolved in water, and the acid is precipitated by means of a solution of subacetate of lead, to be gradually added, in order first to separate a brown colouring matter which arises during the re-action, at least when operating in contact with the air. The last precipitate obtained is colourless, and contains the acid in a state of subsalt; it may then be separated by the usual means.

Besides this acid, another non-volatile body is produced, which possesses the property of immediately reducing, when cold, the salts of silver and of mercury.

The very easy formation of an acid, by the contact of sugar of starch or grapes, with bases, (M. Peligot observes,) shows how proper it is to avoid the employment of too much lime in the purification of the beet root juice; for although lime does not alter the sugar, it acts, when in excess, upon the sugar analogous to that of grapes, into which common sugar is easily converted by the influence of heat, acid, or fermentation. There are therefore two difficulties to be avoided; these may be apprehended at the same time,—the intervention of acids which decompose the sugar intended to be extracted, and the effects of the alkalies which act upon the sugar of starch resulting from this decomposition.

L'Institut, Août, 1837.— Ibid.

*See London and Edinburgh Philosophical Magazine, Vol. XI, p. 152.

Progress of Civil Engineering.

On a peculiar form of Rail, and the construction of Railways in America and Germany, by Herman Koehler, *of Leipzig M. Inst. C. E.*

The pattern, which the author describes, is by American engineers called the inverted T rail, (⊥), and was introduced in order to avoid trouble and expense, which railways are liable to where the rails are placed in chairs and fastened with keys. The material used for this need not be of first quality, but in cases where it is expedient to support a general confidence in the quality of the iron, good and sound rails can be made of $\frac{4}{7}$ths of No. 2, Welsh iron, and $\frac{3}{7}$ths of No. 3, employing the better quality for the head and bottom, and No. 2 for the stem of the rail, rolled in such manner that the lamina of the iron lie horizontally throughout.

The experience of all railways seem to confirm the opinion that chairs and keys to keep the rails firm to their places, are a great and expensive inconvenience, and a dangerous construction, whether wood or iron be the material of the keys. The author then details the advantages of the rail, especially if laid on a continuous line of stone or wooden sleepers at a small distance apart.

Wooden railways are at this time used in Germany, and the author has laid 9 miles between Leipzig and Dresden. Wooden sleepers, 8 inches square, are placed upon trenches cut across the embankment at every yard, and filled up with a bed of broken stones, one foot deep. Notches 3½ inches deep are cut into these cross ties to receive the wooden rails of 6 by 9 inches, which are shod with iron plates of one inch thickness and 2½ inches width. At their joints they are put together on iron plates ⅛th of an inch thick, to prevent their being pressed into the wood. The rails are wedged firmly to the sleepers by wooden wedges. The head of the spikes with which the iron rails are fastened to the wood are of a conical form and fit into corresponding holes, these having an eliptical form to prevent the spike from being drawn or bent on the contraction or expansion of the iron rail. The ends of every iron plate rail are fastened with screw bolts, passing through the whole height of the wooden rails, holding them firmly to their places, which is a very important precaution, as the engines are apt to catch the points of the plate rails with their wheel flanches and to run off.

Trans. Insti. Civ. Eng.—Lon. Jour. Arts & Sci.

On the Construction of Railways of Continuous Bearing, by John Reynolds, *A. Inst. C.E.*

The author states the conditions essential for a good railway to be as follows: 1st. That it should be the closest practical approximation to a perfect plane of perfect stability. 2nd. That it should be adapted to prevent or to neutralize the vibrations from the impact of imperfect cylinders rolling on imperfect planes. 3d. That it should possess the greatest durability and the greatest facility of being repaired which are compatible with the above conditions. Mr. Reynolds proposes trough shaped cast iron bearers, having rectangular bearing surfaces, the angular point being downwards. Thus a section of the bearing part of the rail across its length is a right angle, with its vertex downwards. By this peculiar shape the sustaining area is increased, a greater resis-

tance to vertical pressure is consequently obtained, and the lateral stability of the rail is secured. The rails are to be laid in earth, ashes, or broken stone and gravel, and the sustaining surface of the earth may have any requisite density communicated to it by rolling or beating the earth at the sides, so as to give it sufficient density to resist the pressure to which the rail is to be subjected. The mass being composed of materials which will not readily yield or slip away, will be incapable of further condensation by any subsequent pressure not exceeding that to which it had been originally subjected by the beaters or rollers acting at the sides.

The rails which Mr. Reynolds uses are of two kinds; rails wholly of cast iron, cast in one piece, and rails either of wrought or cast iron laid on a sill of wood, the wood being placed in a cast iron bearer of the shape already described. The rails, sills, and bearers in this latter construction, break joint with each other, and are held together by bolts passing through all three. Thus one continuous structure is formed throughout the whole line, and the fracture of three parts in the same place is highly improbable. The vibrations will be neutralized by the sill of wood acting as a partially elastic cushion in receiving the concussion to which the rails are subjected; and this latter mode of construction is considered preferable as admitting of the use of either cast or wrought iron rails.

February 21, 1837. Bryan Donkin, Esq., in the Chair.

The construction of railways on the principle of continuous bearing, as adopted by Mr. Reynolds, and described in his paper read at the last meeting, was discussed. Some of the rails and bearers cast in a single piece, having been laid on Chatmoss, inquiries were made as to how they had answered. It was stated that they were kept in order at less trouble than the others, and that they showed no tendency to sink. It was intended to use the commonest timber for the sills; the wood having been boiled in tar, and allowed to cool in the tar, becomes so saturated with tar that it will not imbibe moisture. Ibid.

Mechanics' Register.

Medal Striking.

We have much pleasure in announcing to the friends of the fine arts that Mr. Pistrucci, chief medallist in the Royal Mint, has discovered a method by which he can stamp a matrix or a punch from a die which has never been touched by an engraver, and shall yet make a medal identically the same with the original model in wax, an operation by which the beauty and perfection of the master's design are at once transferred to any metal, whether gold, silver, or copper, by striking it according to the usual process. It will at once be seen that this is a very different operation from that by which cast medals are manufactured. It is as simple as it is ingenious, and Mr. Pistrucci having no intention of taking out a patent for the discovery, and being anxious to give to the public the full benefit of it, in the different processes of manufacturing plate, jewellery, and all kinds of ornamental work in metal, announces that the whole of the process consists of the following method:—The model being made in any substance, wax, clay, wood, or other fit material, a

mould of it is taken in plaster, from which mould, when dried and oiled to harden it, an impression is taken in sand, or other similar substance which may be preferred, and from this again a cast is obtained in iron as thin as possible, that the work may come up sharply, and the iron attain the hardness almost of a steel die hardened. The cast iron impression is then flattened mathematically true on the back, and fixed in a steel die, the hollow of which is turned to the exact size of the cast iron, and is set within the rim or border, hammered as close as possible, so as to form a collar. The metal upon which the impression is to be struck, (to form either the medal itself, or a steel matrix if desired,) is to be fashioned into the shape of a cone in the ordinary way, perfectly flat at the base, heated red hot, and placed at the bottom dish of the press. When the die, fitted as above, having been previously placed at the top dish, and the workmen quite ready to give the blows instantly, three or four, as may be required, a perfect impression of the cast iron will be attained without the least injury to it. Of course it will be necessary, previous to the die being used, for the artist to polish the surface. Mr. Pistrucci's first experiment was successfully performed upon a punch of hard copper, with his model of the medal of Sir Gilbert Blane, being nearly three inches in diameter; and he has no doubt that it will equally succeed on a steel punch, perhaps, too, without its being necessary to heat it. When the process above described shall have been brought to the perfection of which it is capable, there can be no doubt that in the execution of works of this description it will not only be the saving of the labor of months or years in the engraving of dies, and, consequently, of great expense, but the work to be executed will in all points be, in an instant, an exact fac simile of the original conception of the artist, instead of representing, as at present, merely the handiwork of the engraver, copied from such original. It will also dispense with the use of the very expensive machinery, such as the *tour a portrait*, introduced into the mint by Mr. Pistrucci several years ago, which, however apparently correct in its productions, can never give a perfectly true semblance of the original, even to the limited extent to which it is applicable. And we may possibly be led by it to discover the mode by which the artists of antiquity succeeded in producing these beautiful coins, in which the softness and boldness of the fleshy parts have never yet been equalled by any modern engraver in steel. Lond. Mec. Mag.

Water Power.

The discovery of a new application of water power, which is likely to be attended with most important consequences, has been lately made by a tradesman in this town. Like all truly valuable discoveries, it is distinguished alike for simplicity and efficiency. It consists of a cylinder and a piston similar to those employed in a steam-engine. To the cylinder there are two entrance and two discharge pipes, one of each on either side of the stuffing-box of the piston. The same turn of the cock that admits the water into the one part of the cylinder opens the discharge pipe in the other, and thus a vacuum is formed. To work this, advantage is taken of the pressure of the Shaw's Water, the height of the reservoir of which gives it a force of 60lb. to the inch in the lower parts of the town. A short time ago we witnessed an experiment

with a cylinder two inches in diameter worked with a jet of water of somewhat less than a quarter of an inch in diameter, and the piston, although loaded with 1½ cwt., rose and fell sixteen times in the minute. In this case the entrance and discharge pipes were equal in size, and the cylinder was placed in a vertical position. Since then the discoverer has had another model made with the cylinder laid horizontally, and with the discharge pipes nearly three times as large as the entrance ones, and by this means the motion was increased to twenty-six double strokes in the minute.—*Greenock Advertiser.* Min. Jour.

Galvanic Telegraph.

The mode of making instantaneous communications by galvanic power has been put to the most decided test on the London and Birmingham Railway, under the direction of Professor Whetstone and Mr. Stephenson, the Engineer. Four copper wires, acted upon at each end of the line at pleasure, by the agency of very simple galvanic communicators have been laid down on the line of the railroad to the extent of 25 miles. They are enclosed in a strong covering of hemp, and each terminus is attached to a diagram, on which the twenty-four letters of the alphabet are engraved, in relative positions, with which the wires communicate, by the aid of movable keys, and indicate the terms of the communication. The gentlemen to whom we have referred, we believe, are fully satisfied that communications to almost any extent may thus be made instantaneously by the agency of galvanism.—*True Sun.* Lond. Mec. Mag.

The Circular Cut.

Most persons remember their surprise, when children, at the great length of thong supplied from a small piece of leather, by the spiral, or, as it is technically called, "the circular cut." The wonder was worked up into a fable, for Dido was said to have obtained the ground on which Carthage stood, by bargaining for as much as a bull's hide would enclose, and then cutting the hide into thongs, so as to take in a space far larger than the seller expected. This story has gone the round of the world. A friend of ours was informed in Persia, that the English obtained possession of Calcutta by the very same stratagem; the Chinese tell the story of one of their emperors; and the North American Indians believe that this was one of the countless artifices by which the white men deceived their brethren. Athenæum. Ibid.

English Railway Stock at Liverpool.

The prices of some or the best of these stocks were,

	Par.	July.	August.
Liverpool and Manchester	£100	£210	£208
Warrington and Newton	100	179	179
London and Birmingham	85	144 10	140
Grand Junction	90	180	170
Leeds and Manchester	10	14 5	13 10
Edinburgh and Glasgow	2	2 7 6	2 7 6

Mining Journal.

Lunar Occultations for April 1838.

LUNAR OCCULTATIONS FOR PHILADELPHIA, APRIL 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
6	14	22	Im. δ Leonès	,4,	80°	128°
6	15	22	Em.		213	264

Meteorological Observations for November, 1837.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer Sun rise.	Barometer 2 P.M	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches	Inches			Inches.	
	1	32°	54°	29.75	29.85	W.	Moderate.		Clear—do.
	2	36	52	29.86	29.90	W.	Brisk.		Clear—do.
	3	37	54	30. 5	30. 5	W.	Moderate.		Clear—do.
	4	38	60	29.95	29.90	W.	do.		Clear—do.
	5	58	70	29 60	29.50	SW.	Blustering.	.8	Cloudy—rain.
	6	44	54	29.60	29.70	W.	Moderate.		Clear—do.
☾	7	48	53	29.65	29.80	W.	Brisk.		Clear—do.
	8	36	45	30.20	30 30	NW.	Moderate.		Clear—do.
	9	31	52	30.35	30.25	E.	do.		Partially cloudy—do. do.
	10	50	63	29.95	29.95	SW.	do.		Cloudy.—partially do.
	11	41	52	30.10	29.95	W.E.	do.	.50	Cloudy—do.—rain in night.
	12	55	61	29.50	29.55	W.	Brisk.		Cloudy—partially—do.
	13	35	49	29.90	29.90	S.	Moderate.		Clear—do.
☺	14	32	33	29.70	29.80	NW.W.	do.	.60	Snow—snow.
	15	26	40	30.00	30. 5	W.	do.		Clear—do.
	16	32	43	30.25	30.10	W.	do.		Cloudy—do.
	17	26	46	30.35	30.3.	W.	do.		Clear—do.
	18	36	54	30.20	30.20	SW.	do.		Cloudy—partially do.
	19	52	62	30.00	30.00	S.	Blustering.		Partially cloudy—clear.
	20	51	67	30.10	30.05	S.	Moderate.		Partially cloudy—clear.
☽	21	49	67	29.97	29.85	SW.	do.		Clear—do.
	22	53	61	29.50	29.30	SSE.	do.	.16	Cloudy—do—rain.
	23	32	39	29.10	29.20	W.	Brisk.		Clear—do.
	24	31	34	29.35	29.40	W.	Moderate.		Cloudy—do—Flurry of snow.
	25	25	30	29.50	29.60	W.	Brisk.		Clear—lightly cloudy.
	26	19	33	29.87	29.95	W.	Moderate.		Clear—do.
	27	25	38	30.20	30.30	W.	do.		Clear—clear.
	28	25	46	30.35	30.35	E.SW.	Calm.		Clear—lightly cloudy.
⊗	29	39	54	30.25	30.20	.SW.	do.		Fog—lightly cloudy.
	30	46	59	39.25	30.10	W	do.		Clear—do.
	Mean	38.00	50.83	29 92	29.91			1.64	

		Thermometer.	Barometer.
Maximum	height during the month	70.00 on 5th.	30.35 on 9th 17th 26th
Minimum	do.	19.00 on 26th.	29.10 on 23rd.
Mean	do.	44.42	29.91

JOURNAL
OF THE
FRANKLIN INSTITUTE
OF THE
State of Pennsylvania,
AND
MECHANICS' REGISTER.

MARCH, 1838.

Practical and Theoretical Mechanics and Chemistry.

On Hydraulic and Common Mortars. By General Treussart, *Inspecteur du Genie. Translated from the French by J. G. Totten, Lt. Col. of Eng. and Brevet Col. United States Army.*

(Continued from p. 94.)

Article ix—*On Concrete. Circumstances in which it is advantageous to use it.*

In Belidor's time many foundations were made by stones thrown into the water, putting over at the same time with the stones, mortar susceptible of hardening in water. This mortar took the name of beton; and this manner of founding was called founding *a pierre perdue.* This method was exposed to the great disadvantage of putting too much mortar in some places, and not enough in others; because, when founding in a great depth, it was not possible to see how to distribute the mortar. Now a days, a practice is adopted of breaking up the stones to the size of an egg, and mixing them, above water, with mortar possessing the property of indurating in water, and then lowering the mixture to the spot where it is required. We have seen that the name of hydraulic mortar is given to that which possesses the property of setting in water, and the name of concrete is now confined to the mixture of this mortar with these broken stones. Concrete is therefore nothing else than the masonry made of small materials; and by making, on the surface, this mixture of hydraulic mortar and broken stones, the great advantage of having a homogeneous mass is secured. If the hydraulic mortar be of good quality, the masonry thus formed is very hard: the quality of the concrete depending, principally, on that of the hydraulic mortar.

The method of mixing small stones with hydraulic mortar in order to form concrete in water, appears to have been employed by the Romans. At page 390, Vol. XX, a passage is cited from Vitruvius, in which he says that very solid constructions are made in water, by mixing together puzzolana, lime and stones, (some authors translate it *small stones.*) I do not know whether any Roman works, made in water, of small stones, have been discovered; but some are found out of water, which are evidently the same

as our modern concrete. It appears that for a long time the ancient method was abandoned; and that it has been resumed, after perceiving the disadvantages of founding with *pierre perdue*.

If good hydraulic mortar be used, without any admixture of stones, the foundation will be not less solid, but much more costly. The stones are added to the mortar in order to lessen, considerably, the expense. To diminish it still more, a certain quantity of gravel is added, occupying a portion of the interstices between the stones. In countries where stones are not to be had at a reasonable rate, broken bricks may be substituted. And in countries where gravel, only, can be had at a cheap rate—both stones and bricks being dear—the concrete may be formed by mixing this gravel with hydraulic mortar. Wherever masonry and concrete are carried on at the same time, all fragments of stones, bricks, and tiles should be saved: these materials may be usefully employed in the concrete, and with great economy; as they will prevent the necessity of purchasing stones or bricks for the purpose of being broken into small fragments for concrete.

When hydraulic works are founded in shallow water, they are often made of masonry of stone and mortar. For this purpose a dam is built around the spot, the water is pumped out, and the masonry goes on as if upon the surface of the dry ground. But when the depth of water is from six to ten feet, the difficulty of keeping the water out is very great; especially in sandy grounds. Much expense is incurred in pumping out the water; the water often forces itself through the masonry; and the mortar is, thereby, drenched, and sometimes far the greater part washed out, which might occasion formidable accidents in the constructions. Lastly, when the depth of water exceeds ten feet—and it is often necessary to found in much greater depth, as in sixteen, twenty, and twenty-six feet—it then becomes impossible to keep the water free, because of the great quantity that enters through every part, preventing, of course, the execution of the work by such means. In this case the foundation is made either in a caisson, or with concrete. The first consists in making a large chest, perfectly tight in the bottom and sides: the masonry is built therein, and in proportion as the load of masonry sinks the caisson, the buoyancy of this last is increased, by adding buoyant bodies, until the masonry is laid in proper quantity; when the caisson is grounded on the exact spot for the foundation. This means is often expensive on account of the construction of the caisson, which requires much care, and is subject to several inconveniences. To found with concrete, the place on which the work is to be laid is surrounded with sheet piles of suitable strength, driven to a depth a little greater than the level at which the work is to be commenced. The earth within the enclosure is withdrawn to the proper depth, then the concrete is deposited in small quantities and in layers. When the concrete has been brought to the level, or nearly to the level, of the surface of the water, further progress is arrested; and it is left until it is sufficiently hardened to sustain the superstructure. If the hydraulic mortar is of good quality, the masonry may be commenced on this concrete foundation, after ten or twelve days of repose. If, for particular reasons, the foundation was not brought quite to the surface, the water may be drawn off down to the surface of the concrete, in order to lay thereon the first courses of masonry. If the ground is consistent, and the concrete is to be carried only to a small depth, the sheet piling may be dispensed with; it being sufficient to dig out the earth in a proper form and to the proper depth. Lastly, if the ground be bad, and the foundation deep, then, after having driven the

sheet piles, and taken out but little earth as a commencement of the excavation, it will be necessary to support the upper part of the sheet piles, to prevent their yielding to the pressure of the earth. An important thing, while the concrete is being sent down, is to prevent, as much as possible, any decided current of water within the enclosure, as this would wash away part of the mortar. Especial care must be taken to make, in the piles, at the level of the surface of the water, an opening, so that the water within shall always be maintained at the same level as the water without; otherwise the difference of level would occasion veins of water through the concrete, which would be very injurious. There might happen to be considerable springs of water in the spot where the foundation is to be made, which would drench the concrete and prevent its setting; in this case the means the most simple of remedying the difficulty, it appears to me, would be the stretching a strong tarred canvass over the springs. There are several modes of transmitting the concrete through the water; one is an inclined trough which conducts it to within a short distance of the bottom; but this means has the disadvantage of making it necessary to divide the concrete into small portions, in order that it may run in the trough, whereby it becomes much washed in the transit. There is the further disadvantage of being obliged, often, to change the place of the trough. Belidor proposed to send down the hydraulic mortar in a box managed with cords, one of which being attached to the bottom, served to upset the box when it had descended low enough. A more convenient mode, though nearly the same, was used at Strasburg; it was as follows: A sort of spoon was made, of strong sheet iron, 20 inches long, and sixteen inches wide; the bottom of the spoon was flat; on the sides and at the back, the iron was turned up square, to the height of six inches, but not in front; the front edge was merely curved upward a little. The spoon was fixed on the sides to an iron handle, having a ring in the middle. This ring was suspended on an iron hook, which was fastened by a socket to a wooden handle; so that the spoon was movable around the point of suspension at the end of the socket, but maintained itself in a horizontal position when filled with concrete. By means of the long wooden handle it was let down to the bottom; when, on pulling a string attached to the back of the spoon, it was upset, the concrete fell out, and the spoon was withdrawn to be again used in the same way. This instrument is very convenient, permitting the distribution of the concrete with facility whenever it may be wanted. It was contrived by Captain Bizos, of the Engineers. When the excavation is large, several workmen are employed, each with a spoon like that described. In No. 4, of the *Memorial de l'Officier du Génie*, will be found the details of the foundation of a baterdeau, with concrete. I will here, however, state succinctly the manner in which the concrete is placed in the situation designed for it, and the precautions necessary to be taken.

When concrete which has been permitted to stiffen somewhat in the air, is deposited in water, it soon softens. A layer is deposited of twelve to sixteen inches in thickness; some time after having softened, it begins to recover consistency. At the end of twelve hours it is to be lightly compressed, and afterward more strongly, by a flat rammer. Whatever precautions may be taken, there is always a portion of the concrete washed out, which forms a layer of soft matter on top of the last stratum. If this soft matter be of some thickness, it will prevent the layers of cement from uniting together; it should therefore be removed, which may be done in several ways. If the foundation be laid in a river, or upon its margin, a

couple of labourers are sent out an hour before the general labours begin, who gently sweep the surface of the beton with hair brooms, thus mixing up this soft matter with the water; they then open small gates which have been prepared a little below the surface, in the upper and lower sides of the enclosure. A current is thus established at the surface of the water within the enclosure, and the turbid water passes off—the sweeping being continued till the water becomes quite clear. The concrete which has begun to harden the preceding night, will not at all suffer by this operation, if it be performed gently. If the situation be such that a current cannot be established, then the soft matter is swept into one corner of the enclosure, and is taken out by drags. If the mass of concrete has not much height, the above operation may be dispensed with; but if its height be as much as six or eight feet, it will be proper to resort to the process two or three times during the execution of the work.

Constructors have considerably differed as to the proportions of stone chips and gravel which should be mixed with the hydraulic mortar. I will give the proportions of the materials forming the concrete used at Strasburg.

The first care is to perfect the mortar which is to serve as the basis of the concrete; for on this depends its quality. The hydraulic lime and the cement that are to be employed, will therefore be tested by the processes I have pointed out. If the hydraulic lime be good, a mortar will be made of this lime and sand, as I have explained in page 268, Vol. XX. I stated that the lime should be slaked at night, by measuring, in a bottomless box, of the capacity of about twelve cubic feet, the quick lime, sand, and other matters: that after having slaked the hydraulic lime with about a quarter of its volume of water to reduce it to powder, it should be covered with the sand and the puzzolana. The experiments I have given show that it is advantageous to let the hydraulic lime repose during twelve hours at least, after being slaked to powder and covered with sand, but that it should not be left in this state more than from ten to fifteen days, before being made into mortar.

If the hydraulic mortar is to be made of fat lime and hydraulic cement, we have seen that there will be an advantage in slaking the fat lime one or two months before hand, with about one third of its volume of water. When the lime has been slaked in this manner, it will be put in a covered place, and at the expiration of the time mentioned, it will be measured either in powder or paste, and mixed with the quantities of sand and hydraulic cement that shall have been found necessary to compose the mortar. If pressed for time, the mortar may be made with lime fresh from the kiln—and it may even be made with lime that has been for a long time melted into cream—but with less advantage.

I suppose then, that hydraulic lime is to be used, and that it has been slaked towards evening, with a quarter of its volume of water, as directed above; the next morning, or several days after, as the case may be, one of the heaps is passed, dry, a couple of times under the Rab; the quantity of water is then added that is necessary to bring it, with thorough mixing, to the ordinary consistence; and if there be no pressing need, it is made into a heap till evening. It is then worked anew with a little more water, and again brought to the ordinary consistence: it is then spread out in an even layer of four to six inches thick, and is covered as uniformly as possible with the stone chips and gravel; the whole will then be several times turned with the shovel until the stones, gravel, and mortar are well mixed together. The concrete being thus made, will be poured into a heap, and left until

it has acquired a degree of stiffness permitting it to be broken up in large pieces.* It is in this state when it is put in the spoon to be lowered down to the bottom, as described above. We have seen, by the experiments of table No. XXVIII, that hydraulic mortars gain sensibly when they are left until they have somewhat stiffened. The time required to come to this state depends on the season: if it be very hot weather, the concrete acquires the due consistence in about twelve hours; generally twenty-four hours are required, and sometimes thirty-six hours.

If the concrete be made of fat lime, sand and hydraulic cement—after having slaked the lime to powder and left it at rest in the air for some time, the mortar will be made as with hydraulic lime, and it will be treated in the same way, to form concrete. We see then, that there is no difference in the manner of using these two kinds of lime, except that with hydraulic lime, to obtain the best results, it is necessary to make the mortar soon after the lime is brought from the kiln; while with fat lime, it is best that the lime be left a month or two in the air after having been slaked.

The quantity of stone-chips and gravel to be mixed with the mortar, has varied much according to different constructors. As I have before said, the object of these matters is to lessen the expense; and such a quantity should be put in as that all the fragments shall be tied together by an adequate quantity of mortar. The first concretes made at Strasburg were composed as follows:

Hydraulic lime measured before being slaked - -	0.75
Sand - - - - - - -	1.50
Gravel - - - - - - -	0.50
Stone-chips - - - - - -	1.00

This concrete was designed for foundations of revetments and other works of that kind.

To make floors of Locks and other hydraulic works, the concrete was composed thus:

Hydraulic lime measured before being slaked	0.75	The resulting bulk of beton was 300
Sand - - - - - - -	0.75	
Trass, or hydraulic cement - - - -	0.75	
Gravel - - - - - - -	0.50	
Stone-chips - - - - - -	1.00	
	3.75	

Experience afterwards taught us that we could make the mortars with one part of Obernai lime measured as quick lime, and two parts and a half of sand, without making it too meagre. As to the other materials, several cubes of concrete of about twenty inches length of side, and containing various proportions of stone-chips and gravel, were made, and put under water in a ditch; and at the end of a year they were broken, with iron masses, to determine the quantity of stone-chips and gravel that might be added without disadvantage. After the experience of these trials, the mortar was made of one part of Obernai quick lime, and two parts and a half

*In the last *Devis Instructife du Genie*, it is said, page 63, that after having mixed the mortar of the concrete with the stone chips, all will be made into a heap to be used immediately; and in note 53, referring thereto, it is said that this is the process that was followed at Strasburg. This is a mistake; at Strasburg the concrete was always left at rest in the air until it had acquired enough consistence to be attacked with the pick, and it was never used immediately after being made. Au.

of sand only, or of sand mixed with hydraulic cement in various proportions, according to the importance of the work. Thus ordinary mortar, whether for the concrete of coarse *(gros)* works, or for gross masonry, was composed of 0.30 of Obernai quick lime and 0.75 of sand. For works more important, the mortar was composed of 0.30 of Obernai quick lime, 0.30 of hydraulic cement, and 0.45 of sand. Sometimes it was made of 0.30 of Obernai quick lime, 0.20 of hydraulic cement, and 0.55 of sand. There was almost always added to this mortar from 0.60 to 0.75 of stone-chips and gravel—nearly in the proportion stated above; that is to say 0.25 of gravel and 0.50 of stone-chips; and it was found that the mortar could bear this quantity without disadvantage. The heaps of beton were thus made up of about 1.80 of materials, which, on being mixed, sustained a diminution of from $\frac{1}{8}$ to $\frac{1}{5}$, according to the proportions used.*

Each heap of concrete, containing about 64 cubic feet of materials, requires four men to make the mortar, mix therewith the stone fragments, and deposite the concrete in the water. If the work requires ten heaps to be made in a day, forty men will be necessary. There will also be required, for such an operation, two intelligent men to slake the lime, and proportion the materials; two workmen, also, will be employed in breaking the stone; and a carpenter will be needed to mend tools, repair scaffoldings, &c., and, lastly, two or three workmen will be wanted for unforeseen calls. There would be great economy in making the mortar by means of the machine described in page 239, vol. xx.

Mr. Vicat thinks that concrete should not be left to take any consistency in the air. According to this Engineer, it should be deposited while it is yet ductile. In the observations made by him upon the pamphlet which I published in 1824, he says: "Mr. Treussart has occupied himself with the management and manipulation of concrete: he is of opinion that concrete which has acquired a degree of stiffness in the air becomes harder in water than when it is immersed of the ordinary consistence, that is to say, soft. That is true; but only when the cohesion of the concrete is preserved, after the immersion, by the aid of some envelope; and this Engineer was wrong in practising the defective method indicated by Belidor, namely, leaving the concrete at rest in the air until it had required such hardness as to be attacked only with the pick, and then to place it in water, where it softened, and loses, afterward, all consistence. I have found that, after eight months, the absolute hardness of a concrete made of puzzolana, immersed according to Belidor's method, was, on an average, to that of the same concrete immersed in a stiff though ductile state, as 15 is to 100."

It would not be difficult to bring forward a great number of facts, completely overturning what is here advanced by Mr. Vicat. In 1818 the baterdeau of Fort Mutin at Strasburg was constructed on a mass of concrete of more than 260 cubic yards. In making the concrete the process given above was followed; and the process of Belidor was pursued in depositing it. Eight days, only, after it had been deposited, the masonry was begun, and was pushed with much activity to completion. This baterdeau

* The above proportions expressed in other terms, are,

Hydraulic lime as before -	0.60	0.60	0.60
Sand - - - -	1.50	0.90	1.10
Hydraulic cement - -		0.60	0.40
Stone-chips -	1.00	1.00	1.00
Gravel - - -	0.50	0.50	0.50

Tr.

sustained, only six months after it was commenced, one of the highest floods of the River Ill, without the occurrence of any kind of accident.

If the concrete became soft, and lost all consistency, as Mr. Vicat supposes, how was it possible to construct the masonry thereon after only eight days? The concrete would have yielded to the weight of the baterdeau if it had not been of strong consistency; and cracks would have appeared at the junction of the old masonry. The baterdeau would have been carried off by the first flood of the Ill, if the concrete had not been very hard. At a later day, we successively built upon foundations of concrete a scouring sluice with five passages, in the great ditch of the Town: then an escape sluice and several other works, and lastly a *canal à poutrelle* in the great ditch, to lead the water to a mill—all the bottom of this canal being of concrete. All these concretes set in a short time, to great hardness; and during the same season, the masonry was constructed on these foundations, without any accident resulting.

Mr. Vicat says that the absolute hardness of a concrete immersed in Belidor's mode is, on the average, compared with that immersed while firm and ductile, as 15 to 100. We have seen by the experiments of table No. XXVIII. that mortar which had been reworked, sometime after it was made, and which had been at rest afterward, before plunging it in water, gave a better result than when immediately immersed. Mr. Vicat admits it to be true, when the cohesion is preserved by the aid of an envelope. I can conceive that this Engineer might have obtained the result he announces, if he destroyed the cohesion of the concrete that he submerged in Belidor's mode; that is to say, if he reduced it to small fragments; but that was not the way we operated at Strasburg. When the heaps had taken some degree of hardness, they were not broken up into small pieces, but they were broken by the pick into large pieces which were transmitted down through the water by means of the spoon above described. On breaking up the heap of concrete into large pieces, there remained some small fragments, though not in considerable quantity, when the concrete had adequately stiffened. These were made anew, into paste with water, and added to the heap of concrete then being made; or transmitted by the spoon and deposited on the concrete under water. I do not therefore think that Belidor's process has any disadvantage: and the considerable works carried on in this way at Strasburg, afforded very good results. The concrete hardened very promptly—Mr. Vicat's operation to the contrary notwithstanding. I do not say there would be great disadvantage in immersing the substance as soon as made; but I believe it would be more exposed to be washed. The process of Belidor was followed at Strasburg, because the experiments which have been cited had taught me that mortars which were destined to be put in water, were better when worked up of the ordinary consistence than when worked up stiff, and that there was a sensible saving in the manipulation. But, in this soft state, the mortar would have been much washed, if put at once into water; for which reason it was left to harden somewhat, according to the advice of Belidor.

It often happens that the floors of sluices, and foundations of hydraulic works, may be built, without being troubled with water. In such cases these floors and these foundations are ordinarily built of stone, resting on grillages: but wood does not unite with masonry, and the mortar often unites badly with the stones: whenever these constructions have to support a considerable pressure of water, leaks will, therefore, be the consequence. In such instances, where floors of locks and foundations of dams can be

constructed without the presence of water, I think it would be preferable to make them of concrete: the expense of grillages would be saved, and they almost always cause leaks. It would be necessary, after the concrete is laid, to cover it with a few inches of water, or with a layer of moist earth: because, in general, hydraulic mortars take a stronger consistence under water, or in humid ground, than when they remain exposed to the air, and especially during summer.

If we notice the retained waters at mills and locks, we see that when the walls are constructed of large cut stones, the water often escapes through the joints, carrying away the mortar, causing a considerable loss of water by leakage, and finally involving the destruction of the works. I am pursuaded that there would often be economy, and always great advantage, in making the side walls of Locks of concrete, instead of stones or bricks, or perhaps the concrete might be restricted to those parts where leaks are most apt to appear.

The use of concrete is very advantageous in the foundations of constructions in water, because it avoids the necessity of drawing off the water, always very expensive, and which has the great disadvantage, by the differences of pressure which result, of giving rise to veins which dilute or wash away the mortar. We have not as yet derived all the advantages that concrete will afford. I am pursuaded that ere long, when it shall be required to construct the piers of a bridge; or a revetment, in a river of from seven feet to twenty feet depth, the method of caissons will be abandoned. The following process, it appears to me, might be followed with advantage.

After having surrounded the space in which the foundation is to be laid with a row of jointed piles in contact, or a row of strong sheet piling; it will be easy to drag out the bottom to the depth of about seven feet, and to fill the excavation with concrete up to the level of the bottom of the river, or a little below, if it be supposed that the works will cause the bottom of the river to be somewhat lowered. When the concrete has been placed, and while it is yet somewhat soft, a second range of sheet piling should be driven into the concrete itself, parallel to and three and a half to five feet distant from the first row. These sheet piles should be driven only about eight inches into the concrete. It will be easy to connect the second row of sheet piles firmly to the first row by means of ties and braces. When this is done, the concrete will be left to take a suitable hardness, and then the space between the rows of piles will be filled with good puddling earth. There will thus be obtained a coffer dam reposing upon concrete; and all the water may be withdrawn from within the inner piling, without leaving any leaks, provided the concrete has hardened sufficiently to resist the pressure of water. It will therefore be easy to build with masonry, upon all that part of the concrete which is within the enclosure.

If it should happen, in consequence of the depth of water, that there was reason to fear the whole bottom of concrete might be raised; this might be easily guarded against by placing wooden trestles on the concrete—these trestles supporting timbers bearing a platform and the necessary load of stones: when the masonry—begun between the trestles, should be sufficiently advanced, this scaffolding with its load would be removed. The masonry being raised above the surface of the water, the inner row of sheet piles may be easily removed and also the earth of the dam. As to the exterior row of piles, or sheet piles; if they have been driven in as deep as six or eight feet, it would be somewhat difficult to remove them. To lessen this difficulty, it would be well, before depositing the concrete, to

stretch some canvass along the lower part of the inside of this outer row of piles, to prevent the concrete from introducing itself into the joints; or lastly, this outer row may be sawed off level with the bottom.

We see that by this method we are obliged to make the foundation rather larger than would be otherwise necessary; but this is no disadvantage to the work as it will increase the stability. If the nature of the ground be such as to require piles under the foundation, they will be driven as in the ordinary method. There will be the advantage of not being obliged to drive them very equally, nor to saw them off at the same level exactly, as is necessary when founding with a caisson. In founding with concrete, it will suffice to drive the piles to the same level within a few inches. When the concrete is sent down, it will spread itself at the same time, on the ground, and around the heads of the piles, to which it will exactly mould itself. If the mass of concrete is from five to seven feet deep, it will form, as it were, an artificial rock resting on piles, and capable of sustaining an immense load of masonry without the slightest injury.

I was under the necessity of studying the project of which I have given above the principal dispositions merely, because we had in view, early in 1825, a bridge on piers of masonry across the Ill, which river is from six to ten feet deep; and, being subject to floods, would have offered great difficulties. I am well convinced that the method I have summarily indicated would have had great advantages over the various modes in use, including the method with caissons; which cost a good deal in the first place, and demand great care in cutting off the piles exactly at a level, and in properly grounding the caisson thereon. Besides it is almost always requisite to surround the foot of the caisson with loose stones, which considerably restrict the passage for the water between the piers, thereby augmenting its velocity, and consequently increasing its wearing action on the bottom. By the method I have suggested, all these inconveniences are avoided: and it is equally applicable to sluices, dry docks, and all other hydraulic structures that are to be made in depths exceeding 20 feet, and where it would become very difficult and expensive to get a foundation by making coffer dams and pumping out the water.

When it is required to build in stagnant water, or where there is a gentle current only, and the materials for a very good concrete are at hand, the whole foundation may then be made of concrete to within a short distance of low water level. It will not be necessary, in this case, to give so great a breadth to the foundation, as in the preceding case; the inner row of sheet piles might be smaller; and they might be separated from the outer row only by the breadth of an ordinary offset in the foundations. No puddling would be needed; all the space within the inner row would be filled with concrete up to low water level nearly, where the stone masonry would be begun. The pier being finished, the two rows of sheet piles would be removed as in the preceding case. When the pier is to be built, thus, of concrete up to low water, the current must be feeble, and the materials whereof to compose the concrete, very good. In cases where one of these conditions is wanting, it will therefore be most safe to use the first method, which brings the concrete no higher than the bed of the river, finishing the rest with masonry, for I doubt if a concrete can be made which will resist the continued action of a current of water, as effectually as masonry made of good stone.

ARTICLE X.—*Summary of the First Section.*

From the facts presented in the foregoing articles, may be deduced the following conclusions.

There are two modes of making hydraulic mortar; first, by making it of lime that is naturally or artificially hydraulic, and of sand; and secondly, by making a mixture of common lime and puzzolana, or of some analagous substance.

In countries where there are good natural hydraulic limes, it is very advantageous to employ them; and in such cases no use should be made of fat lime. In gross masonry, they may be used with sand alone; but when it is required to construct the foundations of sluices, roofs of arches, and other similar works, it is advantageous to add to the mortar, a little hydraulic cement.

In a country where there is no hydraulic lime, in lieu of making it by calcining lime with a little clay, it is more advantageous, and more economical, to make hydraulic mortar by mixing, directly, fat lime with hydraulic cement and sand. The advantage is the greater in countries where there is no chalk, and where it would be necessary to submit the lime stone designed to be made hydraulic, to two successive burnings—burning it the second time with a small quantity of clay.

Fat lime becomes hydraulic by being burned to the proper degree with a little crude clay; this result is not obtained if the clay has been previously calcined. Fat lime also gives a good hydraulic mortar, when it is united in the moist way with a mixture of equal parts of puzzolana and sand, and when the proportion of these substances is at least double that of the lime.

Silex, when it is very finely divided and disseminated in lime stone, produces good hydraulic lime, as is proved by the Senonches lime: when fat lime and finely divided silex are burned together, a hydraulic result, though feeble, is obtained. Iron and the oxide of manganese communicate to lime no hydraulic property: iron in the state of brown or red oxide, prevents the lime from heating much in process of slaking. It does not appear that alumine or magnesia, cause lime to become hydraulic; but when these substances are mixed with silex, good results are obtained. The best process for converting fat lime into hydraulic lime, is to burn it with a small quantity of crude clay; the proportion of $\frac{1}{5}$th of clay, seems the most suitable; and it appears that the best clay is that which contains as much silex as alumine.

The quality of hydraulic lime is improved by mixing with the clay that is to be burned with the lime, a small quantity of water containing soda; a better result is obtained with potash; but this means would be too embarrassing, and would occasion an excess of expense which might not be in proportion to the advantage, were the operations on a large scale.

Hydraulic lime bears less sand than is commonly thought; there are few of these limes which can be mixed mith more than $2\frac{1}{2}$ parts of sand, without sensibly diminishing the resistance of the mortars. Fat lime may take a greater quantity of mixed sand and puzzolana to form hydraulic mortar.

Puzzolanas, or hydraulic cements, which are energetic, apply equally to hydraulic lime and fat lime. In mixing hydraulic lime, or fat lime, with sand and puzzolana, or other analagous substance, in equal parts, a better result is often obtained than by mixing these limes with puzzolana alone

When very hydraulic lime is used, the addition of sand permits a sensible diminution of the quantity of puzzolana, natural or artificial, required to obtain a prompt induration and great resistance. With fat lime there always results a very good mortar, on mixing it, in equal parts, with sand and natural or artificial puzzolana; and if it sometimes happens that a mortar a little superior is obtained with lime and this last substance, without the sand, the advantage is not so great as to compensate for the greater economy of using sand also.

Hydraulic limes are difficult to burn to the proper degree. When they are not sufficiently burned, they slake badly; and the resulting mortar has not all the tenacity it ought to have.* A degree of heat a little greater than it should be, causes, with these limes, a beginning of vitrification; they then slake slowly; the mortar they form loses its force, it swells after having been used, and may occasion considerable injury to the works. Hydraulic limes should be used soon after leaving the kiln; they should not be slaked with much water, like fat limes, nor be left in a state of cream, like them, because, in a very short time they would become very hard, and it would be impossible to make use of them. Whether slaked with a small quantity of water to reduce them to dry powder, or left to slake in the air, they, in general, very soon lose a part of their hydraulic properties, and finally pass to the state of common limes. It is likely that this effect is due to the absorption of oxygen by the hydrate. It would appear that hydraulic limes containing the oxide of maganese preserve their energy better when they have been left to slake in the air than when they have been slaked to powder by water. Notwithstanding the precautions that hydraulic limes demand, it is important to employ them whenever natural limes of this sort, of good quality, can be obtained, because they supply a very good mortar at a cheap rate. We should carefully study the exact point of burning, and should satisfy ourselves, as to whether or not they soon lose their hydraulic property, on exposure to the air, when slaked to dry powder, or when air slaked; without these precautions, we may expose important works to failure, by making very bad mortar out of very good lime. Common lime has not, like hydraulic lime, the inconvenience of losing a part of its qualities by a degree of heat a little greater than that which is most suitable. A very violent fire is required to produce this result. Whether slaked with much water so as to be made into a fluid paste and run into vats, or with a little, only, so as to be reduced to dry powder; or if spontaneously slaked in the air; or if used immediately as it comes from the kiln, a good hydraulic mortar is always obtained by mixing fat lime, in equal parts, with sand and natural or artificial puzzolana. By air slaking the result is the least good. It appears that by slaking in the air, the lime absorbs a considerable quantity of carbonic acid; and the mortar which results is filled with white points, which are particles of carbonate of lime, that cannot be made to disappear, whatever pains may be taken in the mixing process.

The best mode of slaking hydraulic lime is to sprinkle it, as it comes from the kiln, with about one fourth of its bulk of water. A measure containing about one third of a cubic metre (a cube of about three feet three

*This is understood as applying only to hydraulic lime stones which have been burned sufficiently to be employed as lime; as to those which have been burned but very little, to be employed as cements, according to the process of Mr. Lacordaire, I have no experience that will enable me to pronounce as to the tenacity of the mortars they afford. Au.

inches on each side) permits the mixture of the materials that are to compose the mortar, to be easily made. Before sprinkling the lime, it is to be surrounded with the mortars that are to be mixed with it, and when it is slaked and gives out no more vapours, it is to be covered with these mortars. The lime is left in this state for twelve hours at least, and for eight or ten days at most. The quantity of water necessary to bring the mortar to the ordinary consistence is afterward added. Care must be taken to make the mortar no faster than it is needed. The heap of lime surrounded by the sand and other materials should be covered from the rain.

With common lime the process will be a little difficult; being slaked as it comes from the kiln, with one-third of its volume of water, the lime, in a state of powder, should be put under cover, and left in this state for one or two months. At the end of this period it should be measured in paste and mixed with the sand and cement in due proportion, adding the quantity of water necessary to bring it to the consistence of ordinary mortar. This process is the one which gives the best results; but if this be inconvenient, the lime may be used as it comes from the kiln, or after it has been lying wet in vats for any length of time.

A great deal of trituration is useless, either with hydraulic or with common limes. It is enough if the mortar be homogeneous, which is the case when a heap of about thirty-five cubic feet has been passed under the Rab five or six times by four men. Mortar made of ordinary consistence, and even rather thin, is easier to mix thoroughly, and gives better results than when it has been mixed in a stiff state. If it becomes a little dry before being used, there is no objection to working it anew, with the addition of a little water. It might be left from night till morning, to be then passed twice under the rab: the mortar acquires more consistence by moistening it a little. It might be remixed in this way during a couple of days without losing its force.

In mortars made of hydraulic lime, the sand appears to be in a passive state; in hydraulic mortars made with fat lime, the puzzolana or other analogous substance, enters into combination with the lime; and it appears to be that combination which gives to the mortar the property of hardening in water. Fine sand is preferable to coarse for hydraulic mortars; that which is earthy diminishes the force of the mortar considerably.

When one part of quick hydraulic lime is mixed with two parts of sand, the resulting mortar is diminished about one fifth; the diminution is only about one sixth if the mixture be one part lime and two and a half sand.

All clays calcined to the proper degree, and reduced to powder, are susceptible of giving factitious puzzolanas—better or worse, according to the composition. The clays most proper to make good puzzolanas are those which are greasy to the touch—such as are commonly used for making Dutch ware, stone ware, earthen ware and tobacco pipes. Clays which contain one fourth of alumine are greasy to the touch: those which contain from one third to one half, give very good results. The substance of which it is most important to observe the presence in clays, is lime. If this substance exists in the clay in the proportion of one tenth, or more, and the clay be exposed to too great a heat, a cement will be obtained which will not possess the property of causing lime to harden in water; but if it be moderately burned, a good result will be secured. The more lime there is in the clay, the less it should be burned.* When no lime is present, it is

*When I speak of lime contained in the clay, it is meant that the lime is in the state of carbonate. AU.

generally necessary to burn the clay as much as a well burned brick; some clays demand a degree of heat a little greater, according to their proportions of alumine and silex. Even when the clay contains no lime, it should not be too much burned; otherwise it will lose part of its hydraulic property. When it contains up to one-tenth of lime, it requires a less degree of heat than is needed to produce a well burned brick. When it contains more than one tenth, the heat required to burn tiles is sufficient. The clay is supposed to be moulded before burning, into bricks of ordinary dimensions.

When the clays contain only four or five per cent. of lime, some having been properly burned, seem to be benefitted thereby, and others, not; which appears to depend on the proportions in which the silex and alumine exist in the clay. Lime cannot therefore be considered as augmenting, in a sensible degree, the energy of puzzolana; but it has the advantage of bringing the clays more promptly to the proper state of calcination, and making them easier to pulverize: in these respects, therefore, the presence of a little lime tends to economy. Clays which contain about one-third of alumine, and four or five per cent. of lime, appear to be most favourable to the production of puzzolana, provided they be burned to a degree a little below that required to give a well burned brick.

Cement suitable for making a good mortar for heavy masonry, may be made out of ordinary bricks. The dust of tiles, has no advantage over that of bricks, as a cement. The important point is to know the true degree of calcination which the clay requires. Bricks should not be taken indiscriminately from the kiln, but those should be selected which have been found on trial to afford the best hydraulic cement.

Iron gives no energy to Puzzolana; it even seems to be more injurious than beneficial: for ochreous earths did not give good results while with clays entirely without iron, very good were obtained.

Carbonate of magnesia, which is often mixed with clays in small proportion, has no influence when the burning is carried only to the degree proper to yield good hydraulic cements.

Soda does not appear to have a sensible influence in improving hydraulic cements or artificial puzzolanas, but potash has a marked effect. When the clays which it is desired to convert into hydraulic cement, have imbibed a solution of potash, standing at 5° of the *pese acid*, equal in bulk to one-fourth of that of the clay, the cement is sensibly increased in energy; but the advantage to be derived does not appear to me to be so great as to recommend this means in practice. With such clays as I have designated, artificial puzzolanas are obtained, which are in no degree inferior to the natural productions; and by these means, proportioning the cement properly, mortars may be obtained of very great hardness.

Nitrous clays appear to be good for the purpose of being transformed into hydraulic cements: clays containing a little saltpetre (Nitrate of potash) should not, therefore, be rejected.

When the clays that are to be calcined have had a little of the solution of soda, potash, or saltpetre, at 5° of the *pese acid*, added to them, they do not easily lose their hydraulic property by too high a degree of calcination.* This mode would be embarrassing and occasion some expense; but common salt (muriate of soda) might be substituted, and would be but little expensive or troublesome. It appears probable that a like result would

* This is the effect, when the clays contain no lime; but I do not know whether it would be the same, if lime were present. Au.

be obtained with sea water: because we have seen, page 7, that the Dutch make artificial trass of clay which they draw from the bottom of the sea; and which they sell as natural trass.

When the clays to be transformed are calcined with a current of atmospheric air, the mortars harden in the water much more promptly than when the clays are burned out of a current of air. I cannot assert that the resistance of such mortars is much greater, though it appears to me to be probable. As it is important to obtain, in many circumstances, mortars which harden promptly in the water: the clays on these occasions should be calcined in a current of air, in such furnaces as I have described.

Ashes, and the scoria of forges, belong to the class of artificial puzzolanas: there are some which give very good, and others which give very bad results.

Basalt, when calcined to a proper degree, affords good artificial puzzolanas.

Amongst mortars composed of hydraulic lime and sand, those which harden most promptly in water do not always give the greatest resistance: but those do, generally, which are composed of fat lime and puzzolana either natural or artificial. The most certain means of knowing whether hydraulic lime is of good quality, is to reduce it to paste with water, and to plunge it in this state, into water, to see if it hardens speedily: or, otherwise, to mix one part of the lime in paste, with two of sand. To learn the quality of hydraulic cements, or natural puzzolanas, it is proper to make a little mortar, using two parts of cement, and one of fat lime measured in paste, and place it under water.

All hydraulic mortars harden quicker in summer than in winter. If the mortar, made for trial in summer, is composed of hydraulic lime and sand, or if it be composed of hydraulic lime alone, a very good result will be certain, if at the end of eight or ten days the hardening be such that no impression can be made on the essay by pressing strongly with the finger. If this result is obtained only after the lapse of fifteen or twenty days, it is a proof that the lime is only moderately hydraulic.

With mortar made of hydraulic cement and fat lime, a similar induration should be obtained in from three to five days, if the cement be of the first quality, and if it has been calcined in a current of air. Should the hardening take place only at the end of twelve or fifteen days, with cement calcined in a current of air, it may still be employed with advantage. But if the cement has not been calcined with a free current, instead of hardening in from three to five days, it will require from twelve to fifteen, and still give a very good resistance. It may be estimated that, in winter, the induration will demand nearly twice as much time as in summer, without any diminution of the strength of the mortar.

Arenes are clays which have been subjected to the action of fire: they are therefore true natural puzzolanas. It appears that France contains this substance in many places; and it will be found in many more, as researches shall be multiplied. It is with arenes as with natural puzzolanas and trass: all have not, by any means, the same energy: but those which are feeble may be advantageously employed in mortars to be exposed to the air, while those which have more energy may replace hydraulic cements in constructions under water, in the case of ordinary works, and where no circumstances demand a prompt induration.

The use of energetic arenes affords good mortar for masonry in water and in air, at a very cheap rate.

Concrete is nothing else than masonry made of hydraulic mortar and small stones. The use of concrete is of great advantage in founding under water at depths which occasion great expense if pumped dry. Foundations in concrete require little or no pumping: they are capable of supporting the heaviest loads.

The goodness of the concrete depends on the quantity of the hydraulic mortar. It appears that the ancients sometimes constructed with this substance: its use since has been much neglected. All the advantages possible, have not yet been derived from this mode of construction; its advantages will be better appreciated when its use shall be more extended; and when the manner of perfecting hydraulic mortars shall be better understood.

SECTION SECOND.—On Mortars in the Air.

Article xi.—*Of Mortars made of Lime, Sand and Puzzolana.*

If it is of great consequence, in making mortars that are always to remain under water, to be able to make them of good quality; it is of no less consequence to know how to prepare those which are to remain exposed to the air, in such a way that the masonry shall be lasting. People have been struck with the solidity of the remains of Roman masonry, while masonry which we ourselves have erected has often been of very limited duration. All have concurred in attributing the difference to the superiority of Roman mortars. To explain this superiority, it has been supposed that the Romans were possessed of a peculiar manner of slaking lime. Mr. Lafaye published in 1777, a method of slaking, which consisted, as described in our first section, in plunging the lime in the water for a few seconds—the lime being placed in baskets, and then to allow it to slake in the air. He gave this process as a secret recovered from the Romans; and he pretended that by this process as good mortar was obtained as theirs. This made much noise at the time; but it was soon ascertained that although there was some advantage in this mode of slaking lime, it was far from giving the mortars the superior quality the author claimed. Afterward, Mr. Loriot announced that mortar like that of the Romans might be obtained by mixing a certain quantity of powdered quick lime with lime slaked and reduced to paste in the common mode; but experience did not confirm this method of M. Loriot.

Others, to explain the goodness of Roman mortars, have attributed it to the time that has elapsed since the works were executed, whence has come the saying that "mortar is still new that is not one hundred years old," (*le mortar que n'a pas cent ans est encore un enfant.*) But then, it is asked, how comes it that so much masonry perishes before it is an hundred years old, while, in the same climate, some is found which has passed through near twenty centuries without repairs, and far the greater part is still standing? Those who pretend that a great lapse of time is necessary to the induration of mortars, think that the lime absorbs carbonic acid (although situated in the heart of the masonry) and thus passes to the state of carbonate; but several facts contradict this opinion: for there are certain limes which afford very good mortar in a very short time, while others never indurate, as is often seen in demolitions. On the other hand we have seen, in the first section, that according to the analysis of several ancient mor-

tars, many were found which had very great hardness, and which nevertheless contained only a small quantity of carbonic acid; and we know that the lime used in building is never wholly deprived of it. We cannot admit, then, that carbonic acid penetrates far into the interior of masonry; and it is proved, by multiplied observations, that moisture remains during a very long time in the interior of certain walls. Dr. John reports, on this subject, that about ten years ago, they demolished the piers of the Tower of St. Peter's, at Berlin; this tower had been built eighty years, and the pillars were twenty seven feet thick; the mortar on the outside was dry and hard, but that in the middle was as fresh as if it had been lately placed there. I can state that in 1822, that the lower part of a bastion at Strasburg, being under repair, the mortar was found to be as fresh as if just laid, and nevertheless, this bastion was erected in 1666; the revetment was only about seven feet thick, but the moisture of the earth resting against it, prevented the lower part from drying. Similar facts are observed in constructions still more ancient. It results from what has been advanced, that the good quality of the mortars of several ancient structures is not due to the manner of slaking the lime, as Mr. Lafaye supposed, nor to the process of making mortar supposed by Mr. Loriot, nor to the time that has elapsed since they were built. The experiments which follow will confirm this remark; which is in accordance also with general opinion at the present day. The great number of hydraulic works which were to be repaired or rebuilt at Strasburg, induced me to direct my first researches to the object of obtaining good mortars for the water; and it was only when these were well advanced that I began to study mortars for the air. I quitted the place before finishing my experiments. The experiments that I made, though few, appear to me, however, to throw some light on the theory of mortars in the air, and to explain in a satisfactory manner, whence was derived the good quality of the mortars found in many ancient works. It will be useful I think to report them.

It is the opinion of a great many constructors that when common, or fat lime is to be used, it is necessary to have it lie wet in vats or pits for a long time: it is asserted, that the older it is the better it is. The experiments of the following table have for object to verify this important point.

Table No. XXX.

No. of the mortar.	Composition of the mortars,			Weights supported before breaking.
1	Fat lime which had been lying a long time wet—measured in paste	1	3	0
	Sand	2		
2	Same lime	1	3¼	0
	Sand	2¼		
3	Same lime	1	3½	0
	Sand	2½		
4	Same lime	1	3¾	0
	Sand	2¾		
5	Same lime	1	4	0
	Sand	3		

Observations on the Experiments of Table No. XXX.

To make these experiments, I took fat lime which had been slaked and lying wet in a pit for five years—a portion of the same having been used in

the construction of the theatre of Strasburg. The mortars were all made in the same manner, and broken in the same way as the hydraulic mortars; they were left in the air in a cellar for one year before cutting them down to their ultimate dimensions and submitting them to the test: the proportions of sand varied from two up to three parts of sand for one of lime measured in paste. The resulting mortars had no consistency, and crumbled between the fingers with the greatest ease. I confess I was much surprised at the result, for the sand which I used was the same as that used in the mortars of the first section; and, as I have said, was a granitic sand very slightly earthy. I made another experiment with the same lime, and the same sand washed to free it of the small quantity of earth which it contained, but I obtained no better result. I also repeated this essay with another sand, also washed, varying the quantity of water used in making the mortar, but always with results similar to those of the above table, that is to say, mortars without any consistency.

These bad results cannot be attributed to the quality of the lime, for it has been shown by the analysis in page 378, Vol. XX, to be the product of a calcarious carbonate containing only a very small quantity of iron: this is the lime that has been used for a long time both for the public and private edifices of Strasburg. The theatre, as I have observed, was built of this lime: this beautiful structure does not promise, therefore, to be of long duration.

At the same time that I made the experiments of the preceding table with lime and sand, I made corresponding ones with the same lime and trass, and also with lime, sand and trass. The following table gives the results.

Table No. XXXI.

No. of the mortar.	Composition of the mortars.			Weights supported before breaking.	Weights supported before breaking.
				lbs.	lbs.
1	Fat lime which had been lying a long time wet, measured in paste Trass	1 2	3	242	440
2	Same lime Trass	1 2¼	3¼	264	484
3	Same lime Trass	1 2½	3½	286	517
4	Same lime Trass	1 2¾	3¾	341	528
5	Same lime Trass	1 3	4	297	462
6	Same lime Sand Trass	1 1 1	3	286	143
7	Same lime Sand Trass	1 1⅛ 1⅛	3¼	297	165
8	Same lime Sand Trass	1 1¼ 1¼	3½	319	187
9	Same lime Sand Trass	1 1⅜ 1⅜	3¾	330	209
10	Same lime Sand Trass	1 1½ 1½	4	330	209

Observations on the experiments of Table No. XXXI.

All the above mortars were composed of the same old lime as those of the preceding table. The experiments were made in duplicate: those in the first column were prepared in August, 1823, and were left during a year in the air, in a cellar; those of the second column were made in the month of October, 1824, and were left during a year in the air in a chamber where there was no fire. We see that the results are very different: 1st, the five mortars in the first column made of lime and trass only, gave much weaker resistances than the similar mortars in the second column, while it is the inverse with mortars made of lime, sand and trass: 2d, in the first column, the mortars made of lime, sand and trass, gave, in general, better results than the corresponding mortars made of lime and trass only, while it is the inverse in the experiments of the second column.

I am unable to account for the differences shown by these two series of experiments; I cannot say whether, or in what degree, it is to be attributed to their being made at different seasons, and placed in different atmospheres. It is not easy to ascribe such great variations to these two causes; I should rather be inclined to believe that the trass which I used in 1824 was not the same as that used in 1823, and that this has occasioned these opposite results. I purposed repeating these experiments, but my departure from Strasburg in 1825 prevented.

The mortars of the first column of table No. XXXI; were made at the same time as those of table No. XXX; and when, in 1824, I made the experiments of the second column, I also made five mortars like those of No. XXX. and placed them in a chamber—the preceding having been deposited in a cellar. These five mortars, composed of old lime and sand only, remained, like the analogous mortars, without consistence, and were unable to bear any weight.

Seeing that I could get no results with the old moist lime and sand, I made some essays agreeably to the process of Mr. Loriot; they are given in the following table.

Table No. XXXII.

No. of the mortar.	Composition of the mortars.				Weight supported before breaking.
1	Fat lime which had been lying a long time wet, measured in paste Sand		1 2	3	0
2	Lime the same Unslaked fat lime reduced to powder Sand	1-2 1-2	1 2	3	0
3	Lime the same Unslaked fat lime, &c. Sand	2-3 1-3	1 1	3	0
4	Lime the same Unslaked fat lime, &c. Sand	3-4 1-4	1 2	3	0
5	Lime the same Unslaked fat lime, &c. Sand	4-5 1-5	1 2	3	0

Observations on the experiments of Table No. XXXII.

The process of Mr. Loriot consists in mixing a certain quantity of quick lime reduced to powder, with lime which has been lying for some time slaked and wet; and following his method, I varied the quantities of the two kinds of lime, and yet we see, that I obtained no results. The mortar dries quickly, it is true, on account of the presence of the quick lime, but this is not a true induration. The property of drying quickly is what, no doubt, led Mr. Loriot into error. We see, then, that this mode, offered by the author as yielding very good mortars, gives, in fact, only very bad. It is not surprising, after seeing the above results, that the attempt to repoint the platform of the observatory by this method did not succeed.

Having no good results with the old lime, nor with Mr. Loriot's process, I quitted the erroneous methods of others, and made the following experiments.

Table No. XXXIII.

No. of the mortars.	Composition of the mortars.	Made immediately.	After 15 days.	After 1 month.	After 2 months.	After 3 months.	After 4 months.	After 5 months.	After 6 months.	After 7 months.	After 8 months.	After 9 months.	After 10 months.	After 11 months.	After 12 months.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	Fat lime slaked in thick paste . 1 Sand . 2½ = 3½	99	50	44	33	33	33	33	33	22	22	22	22	22	22
2	Same lime . 1 Sand . 1¼ Trass . 1¼ = 3½	319	308	308	297	319	308	319	308	319	352	363	341	319	308
3	Fat lime slaked in thin paste 1 Sand . 2½ = 3½								33	22	22	22	22	22	22
4	Same lime 1 Sand . 1¼ Trass . . 1¼ = 3½								308	297	308	286	297	286	275
5	Fat lime slaked to dry powder and measured in paste . 1 Sand . 2½ = 3½								0	0	0	0	0	0	
6	Same lime 1 Sand . 1¼ Trass . 1¼ = 3½								286	297	330	297	308		

Observations on the experiments of Table No. XXXIII.

These experiments were made at the same time as those of table No. XV, of the first section, and with the same fat lime. I slaked a part as it came from the kiln, giving it only the quantity of water necessary to reduce it to thick paste, and I made therewith the experiments comprised under Nos. 1 and 2. I slaked a part into thin paste, and made with it the experiments under Nos. 3 and 4, and I also slaked a part into dry powder; by giving it a quarter of its volume of water, and with this I made the two series, Nos. 5 and 6. All these experiments comprise the interval of a year, and the several epochs at which they were respectively made are given in the table. The figures of the table give the number of pounds that the mortars supported before breaking.

The series of mortar No. 1, is composed of 1 part fat lime slaked to thick paste, and two parts and a half of sand. We see that the mortar made immediately, acquired a hardness which is not, in fact, very great, but which is passable. The mortars made after fifteen days had nearly one half less consistency; at the end of two months it had two thirds less, and the mortars made after six months had not strength enough to support the weight of the scale pan, &c., which was twenty-two pounds. This result is very remarkable. If we compare it with table No. XXX, of which the mortars being made of lime that had been lying slaked and wet for five years, had no strength, we cannot but think that slaking fat lime into vats and letting it lie there in a wet state, is a mistaken practice. The practice may have been induced from the considerable increase of bulk it gives to fat lime; but the trials I have made show it to be a very bad process, at least with the limes I used.

The series of mortar No. 2, was made of one part of lime in paste, to two and a half parts of sand and trass in equal proportion. The result was very good. It will be noticed that it was best after the 8th, 9th and 10th month. The experiments above having been commenced the middle of November, the greatest resistances correspond to the months of July, August and September. The mortars were deposited in a cellar; but the cellar was one to which external differences of temperature were soon transmitted. In summer, therefore, these mortars were exposed to an atmosphere humid and mild.

The series No. 3 differs from the first only in the lime having been slaked to a thin, instead of a thick paste. The lime was left six months before making any mortar with it. We see that the results were the same, that is to say, were equally bad with those of the first series.

The fourth series differs from the second only in being made of lime slaked thin, while the second series was slaked to a thick paste. I only began to make the mortars after six months had elapsed. We see that the results are good, but rather inferior to those given by lime slaked to a thick paste.

Series No. 5 was made of the same lime, slaked to dry powder. This series was not commenced till six months after the slaking of the lime. The mortars I obtained had no consistency, and crumbled easily between the fingers. The mortars of the first and third series, made at the same period, bad as they were, gave resistance enough to be submitted to fracture. The lime of series No. 5, was slaked by a process analogous to that of Mr. Lafaye, which consists, as I have stated, in plunging the lime for a few seconds into water, then withdrawing it, allowing it to slake of itself, and keeping it for some time before using it; to avoid the embarrassment of the baskets proposed by Mr. Lafaye, I contented myself with throwing on the lime the quantity of water necessary to reduce it to powder, which, in fact, amounts to the same thing. I however obtained no result. It is possible that Mr. Lafaye made his experiments a short time after the slaking of the lime, and comparing them with others made of lime slaked and lying wet for a long time, he found the first to be the best; but it was probably because the lime he employed, like that in the above table, required to be used immediately after being slaked. It appears to me that Mr. Lafaye was deceived in attributing his success to the mode of slaking which he followed.

The experiments of table No. VI were also made with lime slaked to dry powder, mixed with sand and trass. I did not commence these trials till after six months, and I was only able to continue them four months, for

want of time. The results are about the same as those of the fourth series, and a little inferior to those of the second.

In the first four series, the proportions were one part of lime in paste, to two and a half parts of sand and trass. To obtain results with the last two series in which the lime was slaked to powder, that might be compared with these, I took care, when making the mortars of the last two series, to reduce this powder to paste, and to measure it in this state.

If we compare the above table with table No. XV, whereof the mortars were made of the same lime, we shall see that in general the mortars left in the air gave results a little weaker than those put in water.

Table No. XXX has shown the bad quality of mortars made by mixing sand with fat lime that had been slaked and wet for some years. The following are corresponding experiments made with the same lime just from the kiln.

Table No. XXXIV.

No. of the mortars.	Composition of the mortars.			Weights supported before breaking.
				lbs.
1	Fat lime slaked as it came from the kiln and measured in paste immediately Sand	1 2	3	68
2	Same lime Sand	1 $2\frac{1}{4}$	$3\frac{1}{4}$	57
3	Same lime Sand	1 $2\frac{1}{2}$	$3\frac{1}{2}$	44
4	Same lime Sand	1 $2\frac{3}{4}$	$3\frac{3}{4}$	10
5	Same lime Sand	1 3	4	0

Observations on the experiments of Table No. XXXIV.

The experiments of table No. XXXIV, were made with lime just from the kiln. The mortars were made immediately, and with a view to ascertain the quantity of sand which this lime would bear. The results shew that the greatest resistance corresponded to one part of lime measured in paste, and two parts of sand, and that the resistances diminished in proportion as the sand was increased. No. 4 had so little strength that it was unable to support the weight of the scale pan; and No. 5 crumbled readily between the fingers. The proportion in general use is one part of fat lime measured in paste, to two parts of sand. Some constructors think that more sand is requisite, but the trials in table No. XXXIV, do not at all confirm this opinion. I regret not having begun by putting a smaller proportion of sand; these experiments should be repeated.

The experiments of tables Nos. XXX and XXXIV are the same, with this difference, that in table No. XXX, lime which had been slaked and lying wet for some years, was made use of, while, in table No. XXXIV, the mortars were made of lime as soon as it was taken out of the kiln. In table No. XXX, with the old lime, I could get no results, whatever were the proportions; while with the same sort of lime fresh from the kiln, the mortars gave some resistance. I do not know how to account for the mortar No. 3, above, being more than one half weaker than mortar No. 1, of table No. XXXIII, which was made and proportioned in the same manner. The differences may be owing to the degree of burning of the lime. It appears to

me that fat lime loses quality by being worked up with too much water; but I made no experiments to determine the quantity of water proper to be put in these kinds of mortar; these experiments are yet to be made. It results, nevertheless, from the experiments given in the first section, and from those given above, that lime, whether common or hydraulic, does not bear as much sand as is commonly thought; but it appears to be able to bear more trass, whether alone or mixed with sand; which may be attributed to the combination that takes place, in the moist way, between the trass or puzzolana, and the lime. I purposed making some essays with a view to ascertain the quantities of sand and factitious puzzolana that ought to be mixed with fat lime to give mortars of good resistance; but these proportions can only be fixed after numerous trials, and almost all my leisure had been absorbed by my researches as to factitious puzzolana. I should want, before undertaking the experiments on the proportions of mortars, to have some fixed data, so as to avoid too great a number of useless trials. This is a labour that remains to be undertaken; and it will, no doubt, give different results, according to localities, and according to the quality of lime and factitious puzzolana employed. On summing up, it will be perceived that by whatever manner I operated, only indifferent results were obtained by mixing fat lime with sand; while I obtained very good results by mixing one part of fat lime, measured in paste, with two and a half to three parts of sand and trass taken in equal quantities; as may be seen at the end of table No. XXXI, and in the series No. 2, of table No. XXXIII. It will no doubt be objected to me that several demolitions have been made of masonry built of fat lime; and that the mortars have been found very hard. I will answer this objection; but I am first obliged to present several other experiments.

(TO BE CONTINUED.)

Notes on the smelling of Iron by means of Anthracite, and of the origin of the hot blast in the manufacture of that metal; in a letter to the Editor from BENJAMIN B. HOWELL, ESQ.

In the number of this Journal for February 1829, Vol. III, p. 138, we published the specification of a patent for an improvement in the manufacture of iron, which is alluded to in the subjoined letter. It was the intention of Mr. Howell to have followed up his first successful experiments by manufacturing iron in the large way, at as early a period as circumstances would allow; his works, in New Jersey, however, were too remote from the region of anthracite and of iron to admit of this being done to advantage; and other avocations, it seems, prevented the forming of a new establishment in the vicinity of the mines. We have had but little correspondence with Mr. Howell for some years past, but have known that he still cherished an unfaltering confidence in the correctness of his views, and a full determination to carry them out as soon as it could be done with convenience. The intense interest which was felt upon the subject at the time when Mr. Howell's patents were issued, was productive of an active correspondence, as we partook largely of the confidence and the zeal with which Mr. H. was inspired; and the receipt of the letter which we now publish has been a source of much gratification from the revival of the impressions of ten years ago, and the assurance that what was then anticipated of the final triumph of anthracite in the iron manufacture, is now realized.

Dr. Thos. P. Jones, New York, Feb. 24, 1838.

Dear Sir:—I write to recall to your remembrance our correspondence and conversations in 1828, on the subject of manufacturing iron in its various branches, with anthracite as the fuel. It was in that year that I made the successful experiments in reducing the ore, by a single process, to malleable iron, with anthracite, and in puddling pig iron with *heated air*, using that coal for fuel. My Patents bear date in the Autumn of that year.—Prior to that period a good deal of money had been expended in unsuccessful efforts to manufacture pig iron with that coal. In our conversations, and I believe in our correspondence, I expressed my conviction, that these efforts would continue unsuccessful until some plan essentially different from any which had then been practised should be adopted. There seemed both mechanical and chemical difficulties in the way, which no mode then in use appeared likely to obviate, and in every instance since, when I have heard of pig iron having been actually made with anthracite, a critical investigation into the case, has resulted in ascertaining, that however promising it may have been in the outset, in the end it was a failure. Mr. Crane, (in Wales) appears to have been the first to proceed on a large practical scale, and he ascribes its success entirely to the *heated air*—and in this I have no doubt that he is right. When I stated to you the difficulty, owing to the slow combustion of anthracite, of obtaining any thing but a crude product, little better than a mass of scoriæ—entirely undeserving the name of pig or cast iron, being destitute of any portion of carbon—and adverted to the other fact that pig iron remelted with anthracite always *parted* with a portion of carbon; you explained it by remarking that the slow combustion spoken of, caused *all* the carbon to pass off in the form of carbonic acid gas, and no portion of it to unite with the metal, as was the case when either charcoal or coke was used. There was no obviating this with the cold blast—the *heated air* does it effectually,—this, in addition to Mr. Crane's success, *we* have ascertained to our entire satisfaction,—and you will be pleased, I am sure, to learn that we have made good pig iron with *no other fuel* than anthracite; and that too under circumstances of great disadvantage as to the means used, so great indeed, that had we failed it would have been no argument against the process. There are others now trying similar experiments and some have been engaged at it for some time, but in all of which I have yet any precise information, charcoal has been used, to an extent which renders the whole result of doubtful character. Our iron was made without the aid of any other fuel whatever—and I suspect was the first so made on this side of the Atlantic. I mention this to you for several reasons, First, I understand applications have been made for Patents in behalf of Mr. C. and perhaps of others. Mr. C. claims only for the use of heated air, the originality of which as applied to iron, I think I may fairly contest; and secondly, if the application rests on other grounds, then you should know that it has already been done—and certainly before some who I suspect will apply; and thirdly, because as a friend to all improvement I think you will be pleased to know it.

On the subject of heated air, I will state a fact or two and leave you to make the commentary. My patents were taken out in 1828, they were published almost immediately in England—in 1829 the first experiments with it were made there, and the patents followed directly after. By the bye, I have seen in your Journal, two patents, one for the mode of generating the heat, in principle the same as mine, and another for puddling, which,

it might be supposed, had been copied from the drawings which I sent you. While the coal could not be used in the first process, that of puddling was of minor importance—now it must become of value.

In using the plural, *we*, I mean my Sons and myself.

Yours, &c. B. B. Howell.

P. S. The maximum of heat used in England and France, appears to have been 700° of Fahr. and but seldom above the melting point of lead. In the course of our recent experiments we reduced the Rhode Island sand stone (you know what that is) to a *soft paste*, and cast iron exposed to the current of heated air, was melted in half a minute; some of the effects produced by this intensely hot blast require to be seen; they can hardly be realized otherwise. It seems to me, that the use of the hot blast is destined to revolutionize the iron manufacture. The diversity in the accounts of its results in England and France may I think be accounted for, without impeaching the veracity of either of the parties in the controversy, as to its real value and influence on the quality of the iron. B. B. H.

Physical Science.

Observations on the Absorption of Gases by Water. By W. H. Goode, Hampden Sydney College, Va.

The tables of the absorption of gases by water are found in Dr. Turner's chemistry, page 163; one of which is given by Drs. Dalton and Henry, the other by M. De Saussure.

"One hundred cubic inches of distilled and recently boiled water at the mean temperature and pressure, absorb of

	Dalton and Henry.	Saussure.
Sulphuretted Hydrogen,	100 cubic inches.	253 cubic inches.
Carbonic Acid,	100	106
Nitrous Oxide,	100	76
Olefiant Gas,	12.5	15.3
Oxygen	3.7	6.5
Carbonic Oxide,	1.56	6.2
Nitrogen,	1.56	4.1
Hydrogen,	1.56	4.6

The estimate of Saussure," Dr. Turner remarks, "is in general too high. That of Drs. Dalton and Henry, for nitrous oxide, according to the experiments of Sir H. Davy, is considerably beyond the truth."

It is of some practical as well as theoretical importance to determine the actual quantity of any gas, that pure water deprived of the atmospheric air it usually contains, will absorb; and whether the absorption of gases by water, obeys any general law.

These points cannot be considered as settled, when the numerical results obtained from one set of observations so far exceed those obtained from another. The disparity between the tables quoted above, is such as to warrant the opinion that one, and perhaps both are erroneous; and leads us to infer that the methods by which they were obtained were as diverse as the tables are wide of a coincidence.

With the plan of manipulation pursued by Drs. Dalton and Henry, to

obtain their results, I have no means of becoming acquainted. That of Saussure was as follows.

A flask, *m*, holding 250 cubic centimetres, was filled over the pneumatic trough with the gas to be absorbed, and held inverted for half an hour under the water of the trough, that it might acquire the temperature of this liquid, which ought to be nearly that of the atmospheric air. The mouth of the flask was then closed with a conical ground glass stopper. The weight of this flask empty and full of water was accurately determined.

From this flask about a sixth portion of the gas was poured over the mercurial trough into a receiver filled with mercury. This portion was then poured over the water trough into a flask, *n*, filled with water. The weight of this flask before and after the introduction of the gas gave the volume of this last. This volume being abstracted from that in the flask, *m*, originally, gave the volume of gas still remaining in that flask.

Into the flask, *m*, a quantity of distilled, well boiled, water was poured through the mercury, sufficient to expel all the mercury that had been introduced by the third operation. This flask was then closed at the surface of the mercury, and weighed. This gave the volume of water introduced into the flask.

The gas with the water was now strongly agitated for fifteen minutes, while the flask *m* was held by a pair of pincers, to prevent the introduction of heat by the hand. It was then plunged under the water of the trough, to bring it exactly to its original temperature, opened in an inverted position and closed again under water. Now the water which occupied the place of the gas absorbed, and [or] the difference between the weight of the flask, *m*, now and when it was full of water enabled me to know the volume of gas absorbed." (Annals of Philosophy, Vol. VI, p. 347.)

This method of obtaining the absorption of gases by water appears to be liable to some objections.

The capacity of the flask, *m*, as has been noticed by Dr. Dalton, (Ann. Philos. Vol. VII, p. 218.) "was ascertained when it was dry within; but when filled with air for the experiment, it was wet within, and consequently did not contain as much air, by the quantity of water adhering to the glass."

The water of an ordinary pneumatic trough, is scarcely ever of the same temperature at the surface and at a few inches beneath; by contact with the atmosphere, the particles on the surface acquire its temperature, which causes them to become lighter than those below, and to retain their places: the nonconducting material of which pneumatic troughs are usually constructed, preventing the particles beneath the surface from suffering those alternations of temperature to which the atmosphere and the surface of the trough are subject.

The density of the gas in the flask, *m*, after it had been half an hour under the water is increased; the flask will then hold more gas than it held at the atmospheric temperature.

After the flask is placed on the mercury trough, the gas in passing from the temperature of the water to that of the atmosphere, expands; but the removal of the stopper gives it an opportunity of expanding, without affording any means of detecting the amount. Consequently, the volume of gas in *m*, when it was under the water, was less than the volume in *m* and *n*. This is due to the expansion occasioned by the temperature of the atmos-

phere; which is higher than that of the water under the surface of the pneumatic trough.

After agitating the gas and water, the flask was again "plunged under the water of the pneumatic trough to bring it exactly to its original temperature." But when the boiled water was admitted into the flask, the gas in it was at the atmospheric temperature, and not at the temperature of the water under the surface of the pneumatic trough, which ought to be, says Saussure, "nearly that of the atmospheric air." Consequently, a diminution of the bulk of the gas took place when the flask was plunged under the water, and when opened a quantity of water entered sufficient to occupy the place of the gas absorbed, and the diminution of bulk occasioned by lowering its temperature.

These sources of error in his method probably militated against the truth of M. de Saussure's results.

The plan adopted to obtain the results given below, for the less absorbable gases, was to make pure and boiled water absorb as much gas as possible by agitating it in contact with the gas; then liberating the gas from a known weight of this water by boiling; decanting and measuring the gas so liberated with Hare's eudiometer, and determining its bulk by the weight of an equivalent number of measures of distilled water.

A globe about four inches in diameter was fitted with a cap into which a stop-cock was screwed air-tight, the other end of the stop-cock screwing into the plate of the air pump; a small tube reaching nearly to the top of the globe, was cemented into that end of the stop-cock intended for the cap. This tube admitted the globe to be exhausted of its atmospheric air after the boiled water was poured in.

The water used in these experiments was twice distilled, in glass vessels; first over the sand bath, and then slowly over a lamp. After being well boiled, a small portion of it was poured into the globe as hot as could be ventured without endangering the cement with which the cap was fastened. The globe was now screwed to the pump plate, exhausted, and attached to a jar on the pneumatic trough containing the gas to be tried, by means of a connecter and stop-cock, cemented into the top of the jar. By depressing it in the water and opening the stop-cocks, the globe was filled with gas, and again exhausted, to free it as much as possible from any atmospheric air that might have remained in it after the first exhaustion.

The time occupied by these exhaustions reduced the hot water originally put in, to the atmospheric temperature.

The globe was then replaced on the jar and again filled with the gas; care being taken that it should remain attached to the jar for a few minutes, in order that compensation might be made for the reduction of the temperature of the gas when it rushed into the void; and that the level of the water within the jar should coincide with the level of that in the pneumatic trough.

The globe was then detached from the jar and agitated briskly for fifteen minutes; during the agitation it was replaced at least once on the jar, and gas admitted to supply the place of any that might have been absorbed.

Another globe about an inch and a half in diameter, with a neck three inches long was counterpoised, and a portion of the impregnated water weighed into it, after the agitation ceased. This globe was then filled with mercury and inverted in a cup of that fluid; it rested on a ring while its mouth dipped under the mercury in the cup. In this position the water which occupied the highest part of the globe was boiled by means of a small

spirit lamp, the gas collecting in the upper part, and an equal bulk of mercury flowing out at its mouth into the cup, and as soon as it was sufficiently cool to be handled without inconvenience, it was taken to a water trough in which a quantity of common salt had been dissolved to prevent the absorption of gases by the water decanted, and measured with Hare's eudiometer. The bulk of the gas thus obtained was then determined by the weight of an equal number of measures of distilled water.

This method did not answer with carbonic acid, and the protoxide of nitrogen, which are so readily absorbed that the greater portion of them liberated by boiling, was re-absorbed before they could be decanted and measured.

These gases were generated in graduated tubes filled with well washed mercury to free it entirely from saline matter; and after a known volume of pure water was introduced, the tubes were left undisturbed for twelve or twenty four hours. The bulk of gas exposed to the water in the graduated tubes was corrected for the mean temperature and pressure. Barometric pressure exerted no influence when the absorptions were performed in the globe; but the bulk of gas measured at the trough was influenced both by temperature and pressure, for which due corrections were made.

Care was taken that the vessels in which these experiments were performed should be perfectly clean, and entirely free from grease, or saline matter. Whenever there was the slightest appearance that grease had been communicated from the cap to the water within the globe, it was rejected; the globe was then washed in a hot solution of potassa, and well rinsed three or four times, the last time in the boiled water prepared for the experiment. The mercury with which the tubes were filled, was well washed, and drained through a funnel to free it from impurities.

Precautions were also taken to have the gases perfectly pure, by passing them through such solutions as would take up the impurities suspected to be in them. The hydrogen was prepared in a Woulfe's apparatus, by the action of sulphuric acid or zinc, and passed through a solution of corrosive sublimate and potassa, to render it perfectly pure. The carbonic oxide was prepared from sulphuric and oxalic acids, and remained twenty-four hours over water with a stick of potash in it, supported by a wire, to free it entirely from carbonic acid. The protoxide of nitrogen was passed through water to free it from nitrous acid and nitrate of ammonia.

With these precautions the following results have been obtained. One hundred volumes of water at the mean temperature and pressure absorb, of

Hydrogen,	1.82	Vols.	Oxygen,	3.01	Vols.
Carbonic Oxide,	1.92	"	Nitrous Oxide,	55.00	"
Nitrogen,	2.24	"	Carbonic Acid,	139.96	"

one hundred volumes of spring water give off by boiling 205 vols. of gas; but the same quantity of pure water absorbs by agitation, 2.44 vols. of atmospheric air.

Franklin Institute.

Minutes of the Board of Managers.

At a meeting of the Board of Managers, held at the Hall of the Institute, January 24th, 1838,

Mr. John Wiegand was elected Chairman of the Board; and

Messrs. John C. Cresson, and Henry Troth, Curators for the ensuing year.

At a meeting of the Board, held February 21st, the Chairman nominated the standing committees agreeably to the by-laws. On motion, Alfred Langdon Elwyn, M. D. was added to the Committee on the Library; Messrs. James C. Booth and Jacob Peirce were added to the Committee on the Cabinet of Minerals; and Messrs. Joseph M. Truman, John M. Ogden and Briton Corlies were added to the Committee on the Exchange; when the committees were appointed as follows:—

On the Library.

Henry Troth, *Chairman.*
Isaac Hays, M. D.
Thomas Fletcher,
Isaac P. Morris,
J. Henry Bulkley,
Alexander M'Clurg,
Robert M. Patterson,
Alfred Langdon Elwyn, M. D.

On the Cabinet of Models.

John Agnew, *Chairman.*
John Struthers,
Isaac P. Morris,
Andrew M. Eastwick,
John S. Warner,
William Hart Carr,
John Gilder,
William D. Parrish.

On the Cabinet of Minerals.

Isaiah Lukens, *Chairman.*
Samuel Hufty,
Abraham Miller,
William H. Keating,
Charles B. Trego,
Henry D. Rogers,
James C. Booth,
Jacob Peirce.

On Publications.

Isaac Hays, M. D. *Chairman.*
Samuel V. Merrick,
Matthias W. Baldwin,
John C. Cresson,
Robert M. Patterson.

On Premiums and Exhibitions.

John C. Cresson, *Chairman.*
William H. Keating,
Alexander Ferguson,
Thomas Fletcher,
Isaac B. Garrigues,
Alexander M'Clurg,
John S. Warner,
John Agnew.

On Instruction.

Frederick Fraley, *Chairman.*
John Wiegand,
James M. Linnard,
Isaac P. Morris,
Charles B. Trego,
Henry Troth,
Henry D. Rogers.

On Monthly Meetings.

Andrew M. Eastwick, *Chairman.*
Matthias M. Baldwin,
John C. Cresson,
John S. Warner,
William Hart Carr,
J. Henry Bulkley,
William D. Parrish.

On the Exchange.

John S. Warner, *Chairman.*
John Struthers,
Andrew M. Eastwick,
Isaac B. Garrigues,
John Gilder,
Joseph M. Truman,
John M. Ogden,
Briton Corlies.

Managers of the Sinking Fund.

Samuel V. Merrick, *Chairman.*
Frederick Fraley,
Alexander Ferguson.

Auditors.

Isaac B. Garrigues.
William Hart Carr.

On Finance.

William H. Keating, *Chairman.*
Samuel V. Merrick,
Alexander Ferguson.
Frederick Fraley,
Henry Troth,

(Extract from the Minutes.)

John Wiegand, *Chairman.*

William Hamilton, *Actuary.*

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JUNE, 1837.

With Remarks and Exemplifications by the Editor.

111. For improvements in the construction of *Rail Road Cars;* Gustavus Plantou, Administrator of Anthony Plantou, city of Philadelphia, June 3.

This contrivance exhibits a rail road car upon castors. The running wheels are to be grooved to embrace both sides of the rail, and these wheels are embraced between, and have their gudgeons in, two cheeks of metal, which unite at top, forming part of a vertical swivel upon which the wheel, with its embracing cheeks may revolve horizontally. The claim is to "the substitution for the axle now in use, of four upright pivot standards, as above described, which contain the wheels, and possess the power of rotation; also their mode of construction, and their application to any form of car or locomotive that may be used on railroads."

There is no probability that a car upon this plan will ever be essayed, and should it be, we are convinced that its career would end there. The idea that such a wheel would readily adapt itself to curvatures, is manifestly fallacious. It is to swivel round by the action of the two flanches of the wheel upon the rail, and that under the weight of the car and its burthen.

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112. For an improved mode of *Dipping Loco Foco Matches*; John Hatfield, Stillwater, Saratoga county, New York, June 3.

After describing the usual mode of dipping the matches by hand into the igniting composition, which is said to be slow and inaccurate, the mode invented by the patentee is described, and this consists in taking a tube, or cup, which is conical, and inserting a sufficient number of matches, to fill the mouth of it; and hold themselves in, the sulphured ends standing outwards. The conical form of the tube will cause the points of the matches to stand free of each other, and when made even, they may be dipped so that the composition shall just cover their points. The claim is to "the use of a tube with a funnel shaped or diverging mouth, by which an indefinite number of matches may be held and dipped at once, as above specified."

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113. For a *Machine for Making and Drying Bricks;* James Hodges, Anderson District, South Carolina, June 3.

The principal novelty in this machine consists in a furnace for drying the bricks. There is a mixing tube for the clay, in which a shaft, carrying knives is, made to revolve in the usual manner; an apparatus of elevators is to carry the clay into the mixing tub, which is also to be supplied with water from a reservoir. A sieve for sanding the bricks, and a revolving brush for oiling the moulds also form a part of the appendages to the machine. The furnace, above spoken of, extends the whole length of the machine, on one side of it. A railway consisting of two tracks parallel to each other, and united at each end by semicircular rails, forms a continuous road upon which carriages, which receive the bricks as they are pressed, traverse round; this railway passes through a kind of oven in the furnace, and through this therefore the bricks are made to pass. Two vertical shafts carry chain wheels, around which an endless chain passes within the semicircular ends of the railway, and to this chain is attached the carriages with the moulded bricks.

The general construction and operation of this machine is sufficiently apparent, but the particular arrangement of some of the individual parts is not clearly made known, although they are claimed both separately and in combination; these claims consist in "the form of the moulds, and the method of drying the bricks by causing them to pass through a heated kiln, on a revolving endless chain, over ways, instead of drying them in the usual manner; also the method of oiling the moulds, and sanding the bricks."

The machine, as represented, is to be operated by horse power, and it appears that the moulding and pressing are to be carried on continuously; we apprehend, however, that under the arrangement exhibited, so far as it can be understood, there will be found practical difficulties, as the machine is complex. With respect to the drying we are entirely at fault, as it appears to be utterly impossible to effect this in the way described, during the time the bricks are being made: the oven, to be effective, should, we think, be half a mile long, at least.

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114. For improvements in *Boilers for Generating Steam;* James J. Rush, machinist, Philadelphia, June 3 (See specification.)

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115. For improvements in *Trusses for the radical cure of Hernia;* Heber Chase, M. D., city of Philadelphia, June 10. (See Bibliographical Notice, p. 95.)

116. For improvements in the *Machine for Planing Boards;* Samuel Whitney, Dunstable, Hillsborough county, New Hampshire, June 3.

In this machine there is a horizontal planing wheel, furnished with cutters, or irons, for roughing and finishing the board. The boards are to be *fed* in between, and to be drawn on by rollers, as in most other planing machines. The claims, necessarily, are restricted to the particular manner in which the respective parts are combined together, and made to operate. Upon the face of the thing there is not any superiority in this over the machines which have preceded it; but of this it might be unfair to pronounce a definite judgment from a drawing and description only.

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117. For an improvement in the *Cotton Press;* Gideon Fitz, Clinton, Hinds county, Mississippi, June 10.

The claim in this press is "the mode of connecting the screw with the cotton box, by placing the nut of the screw under the box, on a sill, or sills, which sill or sills may be let into the ground in a horizontal manner, and be covered over with earth a few inches deep, to admit the horse or team which carries the lever round, to pass over the sill or sills." In this press the inner end of the sweep rests on a collar and forms the nut of the screw, which as it is carried round, causes the screw and the follower which is attached to its upper end, to rise without revolving, and to press the cotton in the cotton box situated above it.

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118. For an improved *Machine for separating Wild Peas, or other round seeds from grain;* Lester Butler, Cobleskill, Schoharie county, New York, June 3.

This machine consists mainly of a wheel, or round table, which is made to revolve horizontally. Its surface is dishing, or inclines towards the centre, where it is open for the round seeds to fall through it into a receiver extending under the opening. The seed to be cleaned is put into a hopper furnished with a shoe, and the grain falls down nearly on to the middle of the inclined rim, which is kept revolving by its shaft. There is a contrivance for agitating the seed as it passes round, and from the inclination of the rim, the round seeds pass towards, and fall through, the open centre. The wheat, or other elongated grain, is carried by revolving brushes, to the periphery of the wheel, where it falls into a separate receiver prepared for it.

The claim is to "the principle of separating round seeds from the grain, by a horizontal inclined wheel, projected in such a manner as to admit the revolution of the wheel, or plane, a separation of the round seed from grain, and the process of raking the deposit of the hopper, and gathering the grain after being cleansed, into a receiver attached to the machinery."

The specification of this patent is very far from being a model for such instruments, as it is very deficient in clearness.

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119. For improvements in the *Machine for sawing Clapboards;* Samuel Goss, Milford, Hillsborough county, New Hampshire, June 3.

"The applicant claims no part of said machine as new, excepting the guide, as specified, connected with the screw gauges, and the sheff moved by the arm, for sawing clapboards." The guide and shelf spoken of constitute the machinery for canting the bolt at every cut, so that a circular saw may alternately cut a thin and thick edge.

120. For an improvement in the *Machine for Sawing Shingles;* Samuel Goss, Milford, Hillsborough county, New Hampshire, June 3.

The claim in this, as in the clapboard machine, is to "the guide moving on a pivot, as specified, and connected with the arms and screw gauges, for sawing shingles." The principle of action is analagous to that of the last machine, with this difference, that the tilting of the bolt is endwise.

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121. For an improvement in the *Process of Leaching Ashes;* Garret Clement, Canadaigua, Ontario county, New York, June 10. (See specification.)

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122. For a *Machine for breaking and softening Hides, Skins and Leather;* Eli Kendall, Newton, Middlesex county, Connecticut, June 10.

The skins are made to pass over a large roller, to which they are confined, and on which they are carred forward regularly by means of a feed roller which presses upon it. The breaking and softening is effected by means of elastic knives set spirally around a third roller, revolving above that first named. The claim is to "the spring or elastic breakers constructed and applied to the machine for breaking and softening hides, skins, and leather as above described."

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123. For an improvement in the mode of *Making a Batting, or Web, for Hat Bodies;* Thomas Blanchard, city of New York, June 14.

The claim made by the patentee will afford a good general idea of the operation of the above named machine; its particular construction cannot be given without the drawings. The *fancy*, and other rollers are employed to prepare the fur, in the same manner as in some other machines. And the patentee says that "the quick fancy that throws the fur from the doffer will raise a sufficient current of air by its rapid motion to carry the fur to the roller, with the assistance of the draught of the fan. I do not claim the fan as my invention, nor the wire vellum apron, nor any part separately. But I do claim as my improvement, or invention, the forming of a batt or web, of fur by throwing the fur into a chamber, and depositing it on an endless web of wire cloth, or vellum, revolving around two extended rollers, and by exhausting said chamber of air by a revolving fan on the other side of said chamber; the air passing through the wire cloth deposits the fur upon it, and draws it tight upon the wire cloth, at the same time the wire cloth is performing its progressive motion, and carries the fur under a vibrating roller which hardens it to a sufficient tenacity to be handled and formed into hat bodies, or used for naps; and the arrangement and combination of the above machinery, and parts of machinery, in the manner described and set forth, and for the purposes aforesaid."

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124. For a *Stove for heating Irons for Hatters, Tailors, &c.;* Bartholomew W. Taber, Falmouth, Barnstable county, Massachusetts, June 10. (See specification.)

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125. For an improvement in the method of *Protecting Timber from destruction by Worms and Dry Rot;* August Gotthilff, City of New York, June 14. (See specification.)

126. For an improvement in the *Plough*; Bancroft Woodcock, Mount Pleasant, Westmoreland county, Pennsylvania, June 14.

The numerous patents for ploughs hardly admit of any other novelty than some particular mode of constructing certain parts, so as to render their renewal easy as they wear out, or of putting the respective parts together. The claims made by Mr. Woodcock are "with reference to the share, the making it with plane surfaces instead of curved ones; continuing such surfaces to the shoulder on each side, so as to leave the metal throughout so thin that when it wears off by use, the share will still present a thin edge to the ground. Also the reversing cutter received into a recess on the land side, and capable of having either of its edges presented forward, so as to form the cutting edge of the plough, and secured in its place on the land side by a wedge, or wedges, or in any other manner which may be preferred. Likewise the mode of forming the renewable point as specifically set forth."

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127. For improvements in the *Machine for Breaking Hemp and Flax;* John Warren, Westbrook, Cumberland county, Maine, June 14.

This is an ingeniously contrived machine, and it has been preceded by several others, meriting the same character; but none of which have been found to operate advantageously in continued use. In this machine the hemp or flax is held in a clamp, from which it hangs down vertically, there being the necessary contrivance to allow it to be raised up and down, as it is fed between breakers which slide horizontally, the slats on one passing between those of the other.

The claim is to the "manner of constructing a machine for breaking hemp and flax, as described; that is to say, with a movable brake acting horizontally upon a stationary brake, by means of cranks or other analagous contrivance, with metal or other blades attached to them, and operating in the manner set forth. Also the arrangement of the clamp, and other parts of the feeding apparatus by which they are adapted to operate in conjunction with the said horizontal brakes."

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128. For an improvement in the *Machine for Breaking and Dressing Flax and Hemp;* Harvey Lull, Ithica, Tompkins county, New York, June 14. (See specification.)

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129. For an improvement in *Anthracite Coal Stoves;* Aaron O. Price, Newark, Essex county, New Jersey, June 14.

The main feature of novelty in this stove, or grate, is the enclosing an open fire place by transparent doors, which may be made to open or to slide laterally.

"The principle claimed by me as original is the substitution of an open grate in a mica or glass case, instead of a furnace, or pot to contain the coal. The advantage of my principle is the whole fire being visible, giving a beautiful and pleasant light, and the heat radiated without obstruction, making it as safe as any close stove, with the advantage of an open grate." Notwithstanding all the advantages set forth, we do not believe that this stove is destined to go into extensive use.

130. For improvements in *Harness for Horses in Shafts;* Robert Beale, city of Washington, June 15.

This harness is so constructed, that the driver can very readily disengage the horse, leaving him untrammelled, and freeing him entirely from the carriage. The claim made is to "the mode of constructing the apparatus described, by means of which the two halves of the back band, or saddle tug are connected together, and instantaneously disengaged, so as to free the horse from the shafts of the carriage; in combination therewith I also claim the manner herein set forth of causing the horse to draw by means of what I have denominated a tug plate, and trace staple, constructed and operating substantially in the manner herein shown."

The apparatus described is simple, and would be efficient; but experience proves that no device of the kind will go into general use; when first exhibited, persons are pleased with them, but riders do not intend to be run away with, or to carry with them a perpetual memento that they are liable to this accident; and even when this does occur, there would frequently be more danger in suddenly disengaging the horse, than in taking the risk of keeping him in the shafts.

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131. For an improvment in *Capstans for Ships*, and for other purposes; Increase Wilson and Francis Beckwith, New London, Connecticut, June 15.

This capstan has two vertical barrels, instead of one, and these are about a foot in diameter, and placed six inches apart. At their upper and lower ends they are to be geared together by cog wheels, to insure their uniform action. The head of one projects up, as usual, to receive the levers, or handspikes, by which they are to be turned. A number of grooves or scores, is cut round each barrel to receive the rope, which is to go round the two, crossing between them. "The size of the barrels, wheels, and scores, as also their number, may be varied, and also the materials of which they may be made. What we claim, therefore, as our invention, and desire to secure by letters patent, is the combination, as before described, of two barrels with wheels, scores, and ropes so arranged as to receive the rope uniformly on to one end of the barrels, and conduct it steadily on and off the other, as specified."

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132. For an improvement in the *Machine for Scraping Hides;* Reuben Shailor, Haddam, Middlesex county, Connecticut, June 19.

The claim is to "the combination and arrangement of the several parts of the machine for scraping hides, as set forth, by which the scraping is performed by placing the hides on the surface of a revolving cylinder, and causing a frame containing several knives, or scrapers, to move by common band or cog gearing, backward and forward over the hides, at right angles to the motion of the cylinders, by which they are thoroughly scraped in every part; the knives, or scrapers, having also an alternate vertical movement, caused by the vibrating lever, or beam with a wheel in each end passing over inclined planes near each end of the frame."

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133. For an improvement in the process of *Divesting Caoutchouc of its adhesive properties, &c.;* Charles Goodyear, city of New York, June 17. (See specification.)

134. For an improvement in the construction of ***Mopheads***, and the mode of securing them upon handles; Jacob Howe, Worcester, Worcester county, Massachusetts, June 15.

The head which is to hold the materials which are to form the mop, consists of two parallel bars, which, by means of a screw that passes into the handle, may be drawn together so as to hold the cloth, or other material.

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135. For a *Machine for cutting Dye Wood;* Lucilius H. Moseley, Poughkeepsie, Dutchess county, New York, June 22.

A vertical shaft is made to revolve by means of bevil gear, or otherwise, the upper end of this shaft carries a conical cup of cast iron, the apex being downwards, and the mouth sufficiently large to receive the ends of such stuff as is to be cut. One or more knives are to be fixed in the cup, extended from the bottom to the top, and the log of wood is clamped in a sliding gate above the cup, so that the wood will descend by its own gravity. When small pieces are to be cut, which cannot be held in the clamp, they are put into the cup, and are prevented from revolving with it by means of a stationary division piece to be affixed to the machine for that purpose. The claim is to "the employment of a hollow conical cup to carry the cutters, in the manner set forth; and also to the using in such a cup, a check, or division piece, by which the smaller pieces of stuff may be cut."

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136. For *Mills for grinding Coffee and other substances;* Hiram Twiss, Meriden, New Haven county, Connecticut, June 19.

This mill has a cylindrical nut, which revolves in a hollow cylindrical case, to which there are appended several contrivances alluded to in the claim, such as a cleaning cylinder, and a cracker, neither of which will be here described, and we think them of but little value, whilst they render the machine unnecessarily complex. There are but few articles of domestic economy the office of which is better performed than that of the ordinary coffee mill, leaving little to be desired excepting in the human machine, by the aid of which the berry is to be roasted, and the beverage prepared.

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137. For improvments in the instrument for ***Extracting Hair from Skins;*** Edward Flint, city of New York, June 30.

The patentee denominates this instrument a *clamp* fur knife, and claims "the combination and arrangement of the clamp with the cushion and blade, confined and operated by means of a spring, hinge, or pivot, or otherwise, and together forming substantially, in the manner described, a new hand instrument, knife, or pincers, for extracting hairs from fur skins." Although this instrument cannot be called complex, it cannot be readily described without giving a greater space than is thought proper to an article in which but few would feel an interest.

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138. For improvements in ***Managing Saccharine, Vinous, and Acetous Fermentation;*** John J. C. Sheridan, city of London, a subject of the King of Great Britain, June 30.

The specification of this patent is of great length; we intend, therefore, hereafter, to prepare an abstract of it, furnishing all the details, so far as they may be necessary to make the nature and merits of the process known.

139. For an improvment in *Lamps for Lighting Houses;* Samuel Rust, city of New York, June 30.

The metallic stoppel of this lamp is ground so as to fit into the neck of a glass lamp, passing in like a cork, or rather like the ground stopper of a decanter; thus avoiding the troublesome appendage of a screw, or the imperfect device of a cork. The wick in this lamp is to be raised by a roller, as in Mr. Rust's other lamps. We have them in use, and find them excellent. The claim is to the grinding in of the stopple, as described.

140. For improvments in the *Machine for Morticing Timber;* Thomas H. Hoskins, Springfield, Clark county, Ohio, June 30.

The bed of this machine is an inclined plane, the chisels working in this direction instead of vertically, as in other morticing machines. There is also considerable peculiarity in its construction in other respects, which cannot be understood without the drawing. The claim is to "the general arrangement and combination of the operating parts thereof, as peculiar in their character; that is to say, the arrangement of the wedge formed pieces, by which, and their connection with the treadle, the mortice chisel is made to traverse backward and forward on an inclined plane, together with the arrangement of the straps, weights and screws, for moving the traverse bar."

141. For improvements in *Lamps and Lamp Torches;* Jeremiah Marting, Boston, Massachusetts, June 30.

The drawing represents a swinging lamp, or torch, such as is used by our firemen. The burner, or tube, for containing the wick, is surmounted at its lower end by a cup into which any superfluous oil may flow from the wick, and thence through holes leading into the body of the lamp. The purpose answered by this cup, and the holes above spoken of, is the same with the analogous contrivance in our common lamps, where the stopple is made dishing, and there is a hole for ventilation, and to allow the waste oil to return in the lamp. The claim is to "the said improvement as above described, for the purpose set forth."

142. For an improvement in the *Open Fireplace, or Grate;* Roger M. Sherman, Fairfield, Fairfield county, Connecticut, June 30.

The heated air from the fire is to circulate through several rectangular flat boxes, called radiators, and connected together by flues. There is nothing very peculiar in the general arrangement, but still the form of the apparatus differs sufficiently from that of some others constructed for the same purpose, to justify the grant of a patent. The claim is to "the combination of the open fireplace with the radiators placed over it horizontally. connected by several flues with the chamber, and with each other, as described."

143. For an improvement in cast iron *Press Cases for Tobacco;* Granville D. Allen, Richmond, Virginia, June 30.

This press case is a cast iron box, within which the box into which the tobacco is to be prized, is enclosed, and fits it closely. The press case has flanches, or ears, at its corners, to receive screw bolts, which keep it firmly together, and allow it to be taken apart for the removal of one box, and the

insertion of another. The claim is to "the press case with diagonal flanches, or ears, connected by screws, or key bolts."

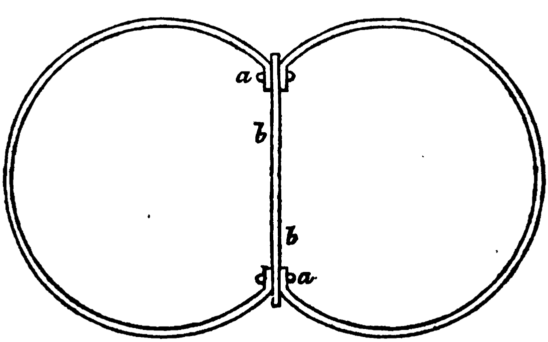
147. For an improvement in *Constructing the Frame work of a Portable Horse Power;* John A. Nelson and J. P. Ross, Lewisburg, Union county, Pennsylvania, June 30.

The frame work, for a horse power, above alluded to, is believed by the patentees to be peculiarly firm and compact; they "claim the constructing it with the sill and cap pieces crossed in the manner described, and connected together by upright posts, with girths to brace them and to sustain the gearing; the whole combined together substantially in the manner set forth."

SPECIFICATIONS OF AMERICAN PATENTS.

Abstract of the Specification of a Patent for improvements in boilers for generating steam for Steam Engines; granted to JAMES J. RUSH, *city of Philadelphia, June* 3*rd*, 1837.

The general principle upon which I construct my boilers is that of combining together two, three, or more sections of cylinders, in lieu of two, or more, perfect cylinders, placed side by side; such sections of cylinders having tubes within them, constructed and operating in the manner of those ordinarily used in locomotive steam engines. The accompanying sketch is a cross section of two such cylindrical sections united together, by rivets or bolts, *a, a,* and to the diaphragm, or plate, *b, b,* extending the whole length of the boilers. The cylindrical parts of such a boiler may be three feet six inches in diameter, and their conjugate diameters six feet, more or less. Such boilers do not differ in the general mode of arranging the tubes for the passage of heat, from those in general use. I intend in general, to surmount these boilers by steam chambers, which steam chambers, however, I do not claim as constituting any part of my invention. Three or more sectional cylindrical boilers may be connected together in the same way, with the former. The combining together of boilers consisting of sections of cylinders, as herein described, constitutes my first improvement.



My second improvement consists in the using of sheets of wove wire, or wire gauze, of a fine texture, similar to that employed in bolting machines,

to prevent the rising of the water into the steam chamber, and the consequent throwing of a quantity thereof, into the cylinder, intermingled with the steam. For this purpose I stretch sheets of wire gauze upon suitable frames, which frames are allowed to float upon the surface of the water in the boilers; or I stretch such sheets of wire gauze across the tubes which connect the boiler, with the steam chambers, or I place them in any other manner which convenience or the particular construction of the boiler may suggest, so that the sheet, or sheets may be interposed between the water in the boiler, and the steam chamber, or reservoir; where it will have the effect of breaking the rising bubbles, and of separating the water and steam from each other.

I am aware that wisps, or tangles of wire have been placed in steam pipes, with a view to the obtaining of the end proposed by me, but my plan of interposing a sheet of wire gauze, just above the surface of the water, which I have found to answer the intended purpose in the most perfect manner, is, as I believe, essentially new.

What I claim as constituting my improvements in boilers for the generating of steam is, first, the combining together of two, three, or more boilers in cylindrical sections, in the manner, or upon the principles herein fully set forth; and, secondly, the placing of a sheet of wire guaze, or wove wire, at or near the surface of the water in steam boilers, substantially in the manner, and for the purpose above made known and described.

James J. Rush.

Specification of a Patent for a new method of leaching ashes for manufacturing Potashes; granted to Garret Clement, *Canandaigua, Ontario county, New York, June 10th,* 1837.

Let the Leach be set in the usual manner and of such size as is found convenient; but the size most approved, is such as to contain ten bushels of ashes.

In filling the leach, spread on the bottom one bushel of slaked lime, and in the centre of the leach, place a small quantity, about three quarts, of unslaked lime, then put in five bushels of ashes, and on the ashes pour fifty gallons of boiling hot lime-water; next place in the centre of the leach one peck of unslaked lime, heated in the arch to a red heat, and on the lime place half a bushel of ashes taken hot from the arch; next put in five bushels of ashes, and on this pour hot lime water until the leach begins to run. And as soon as the hot water has run down in the ashes, put on cold water as much as is necessary.

What I claim as a new invention in this specification, and for which I wish to secure Letters Patent, is the use of hot unslaked lime and hot ashes, and the manner of disposing of them in setting up the leach, by means of which a degree of heat is produced and continued in the leach greater than can be secured by any other known means, and in this manner a leach is run down in six hours, being a shorter time, and the strength of the ashes more fully extracted, than by any other known method.

Garret Clement.

Remarks by the Editor—We are really at a loss to discover the rationale of the operation of heated unslaked lime, as above used in the manufactu-

ring of Potash. The heat may, undoubtedly, facilitate the process, but to afford this, unslaked lime is certainly not necessary; heat has, in fact, been applied by others as fully as it is proposed to be applied in the foregoing process.

Specification of a Patent for a Stove for heating irons for the use of Hatters, Tailors, &c.; granted to BARTHOLOMEW W. TABER, *Falmouth, Barnstable county, Massachusetts, June 10th,* 1837.

To all whom it may concern, be it known, that I, Bartholomew W. Taber of Falmouth, in the county of Barnstable, and State of Massachusetts, have invented an improved stove for heating irons for the use of Tailors, Hatters, &c., and I do hereby declare that the following is a full and exact description thereof.

This stove is intended to be used with anthracite as fuel, but other kinds may be burnt in it. The most convenient form is rectangular, the plates being, in general, of cast iron, and put together in the usual manner. The fuel is contained in a grate with front and bottom bars such as are commonly employed in open fire places, and frequently in close stoves, there being a door in front by which the grate may be enclosed, and another above it for replenishing the fire. The receptacles for the irons to be heated are at each side of the fire, and consist of small compartments, like ovens, which are closed by doors that slide up and down; each of these compartments must be sufficiently long and deep to contain the goose, or pressing iron, which is to be laid upon its side within it, the handle standing out, so that when a door or shutter which closes the compartment is slid down, the handle of the iron is without, exposed to the air, there being two notches in the lower edges of each of these sliding shutters, to allow it to close over the two ends of the handle.

The distinguishing feature of this stove, as applied to the heating of irons is, that the irons are exposed to the direct action of the fire, there being bars at each end of the grate, which bars constitute the division between the fire and the compartments, so that the faces of the contained irons are exposed to it, as they would be if exposed against the front bars of an open grate, whilst, at the same time, they are confined within a small oven, or enclosed compartment, in which they will be rapidly heated. For an exemplification of the manner in which this stove may be constructed, I refer to the drawing thereof deposited in the Patent Office.

What I claim as my invention, and wish to secure by Letters Patent, is the constructing of a stove for heating irons, having compartments to receive them in which the irons are exposed to the direct action of the fire, whilst they are enclosed by doors, shutters, or slides substantially in the manner herein described; not intending by this description to limit myself to any particular form of stove, or to the number of heating compartments, or of the sides thereof on which such compartments may be situated.

BARTHOLOMEW W. TABER.

Specification of a Patent for a method of protecting timber from destruction by worms, dry rot, or other processes of spontaneous decay; granted to AUGUST GOTTHILFF, *city of New York, June 14th,* 1837.

To all whom it may concern: be it known, that I, August Gotthilff, of the

city of New York, in the state of New York, have invented a method of protecting timber from destruction by worms, dry rot, or other processes of spontaneous decay, by the application of materials thereto, which have not heretofore been applied to the same purpose, in the same way; and I do hereby declare that the following is a full and exact description thereof.

I saturate the timber with either of the following articles, either alone or combined with common salt; or I use two or more of them so mixed, or combined, as may be preferred; that is to say, I take common vegetable tar, pitch, the tar-like residuum from the manufacture of illuminating gas, in gas works where animal or vegetable oil, rosin, a mixture of oil and rosin, or any vegetable oleaginous or resinous substance is employed for the production of the gas, and I melt or combine them together in such proportions as may appear best, adding, in most cases, to these resinous materials, and more especially when the timber to be saturated is of a very porous kind, from one-eighth to one-fourth part of their weight of common salt.

As these materials are to enter, and fill, the pores of the wood, by the aid of heat, it may be necessary, sometimes, to dilute them, and this I do by means of spirits of turpentine, or of an analogous solvent distilled from any of the above enumerated materials; this, however will rarely be necessary. To effect perfect saturation, I place the timber and the resinous materials together, in suitable metallic troughs, or tanks, the quantity of the resinous matter being sufficient to cover the timber; the whole is then submitted to a temperature of from three to four hundred degrees of Fahr. scale, for a term which may vary from one to twelve, or more, hours, dependent upon the size and nature of the timber; after which the redundant heated fluid is to be drawn off, when it will be found that the timber will be saturated throughout. The well known processes of exhaustion, and pressure may be applied to promote the saturation, but it is not believed that this will ever be required.

What I claim as constituting my invention is the application of the tar, pitch, and other analogous materials, obtained from vegetable substances, by the agency of heat, to the various kinds of timber, in the manner described, so as completely to saturate the same; using these various materials, in some cases, in combination with common salt; but it is to be distinctly understood, that I claim the saturating of timber with the vegetable products within mentioned, by submersing the timber therein, in a heated state, without, as well as with, the addition of common salt.

AUGUST GOTTHILFF.

Specification of a Patent for a machine for Breaking and Dressing Hemp and Flax; granted to HARVEY LULL, *Ithaca, Tompkins county, New York, June 14th,* 1837.

To all whom it may concern, be it known, that I, Harvey Lull, of Ithaca; in the county of Tompkins, and State of New York, have invented an improved machine for the purpose of breaking and dressing hemp and flax; and I do hereby declare that the following is a full and exact description thereof.

Upon a main shaft, the gudgeons of which are sustained in any suitable frame, I fix two circular heads, which for an ordinary sized machine for hemp may be three feet in diameter, and three feet six inches apart. Between these heads there are to be fluted breaking rollers, which have

their bearings near the peripheries of these heads, or in circular plates. These rollers may be of cast iron, or of wood covered with metal; they extend from one circular head to the other, and may be ten inches in diameter. They are fluted from end to end by deep angular flutes, each of which may constitute two sides of an equilateral triangle, and of these there are upon each roller usually ten in number. Two or more such rollers are placed at equal distance apart, with their teeth projecting beyond the edges of the plates in which their gudgeons revolve. Knives for dressing the hemp, or flax, extend across from head to head, there being one in advance of each roller, nearly in contact with it, and having its blade in the direction of the peripheries of the circular heads, and on a level with them, whilst they are strengthened by a strip on their backs at the under sides of them.

The breaking is to be effected by means of metallic plates, or slats, with the aid of the above named fluted rollers, within the flutes of which they are to be received, their conjoint action effecting the object. These slats may be of the same length with the rollers, four or five inches wide, and one-fourth of an inch thick; and they are to be so fixed that they may be made to pass to a greater, or a less depth within the roller flutes, as the breaking proceeds; the rollers also must be made to revolve on their own axes, and both of these objects I effect in the following manner.

I prepare two flat circular plates, or hoops, usually of cast-iron, which are to be of such size, and so attached to the frame of the machine, as that they shall surround the fluted rollers, near each of their ends. One of these hoops is round on its inner edge, and the opening therein of such diameter as just to allow the fluted rollers to revolve, and to be carried round by the main shaft, within, without touching it; this plate or ring, is about three inches wide. The opposite plate differs from this first in being furnished with teeth on its inner edge, which mash into the flutes, or teeth, of the fluted rollers, which play with freedom in them. The effect of this arrangement, is that when the main shaft, carrying the cylinder of fluted rollers and knives is made to revolve, the individual rollers will likewise revolve on their own axes.

The slats which are to pass between the teeth of the fluted rollers are received between the two last described hollow circular plates, extending from one of them to the other, and sliding in and out, in notches, or grooves, prepared for that purpose, their planes pointing towards the centre of the main shaft, and standing in the middle of each of the teeth, by which the rollers are turned. The number of these slats may vary, but eight will usually answer the intended purpose; they occupy the upper portion of the machine, commencing about twenty degrees from its top on the feeding side, and extending about one-fourth of the way round.

I have said that these slats are made to slide in and out, as may be required, and this sliding I effect by making a projecting tongue on each end of them, which tongues are received into grooves upon movable curved plates adapted to the inner sides of the hoops, or rings, by which the slats are sustained; the grooves, above named, form inclined planes, so placed that when the curved plates are made to slide back or forth within the circle, the slats are simultaneously forced in or out; they are made to slide by means of a cranked lever attached to their

ends, and which crosses the machine. Instead of tongues, there may be notches on each end of the slats, having inclined tongues, or fillets, fitted into them; and the sliding of the slats also, may be effected in other ways.

When this machine is used, the main shaft is to be made to revolve by any competent power; the tow or flax is to be held in the hand or in a gripe made for the purpose, and fed in upon the revolving rollers, by which it will be carried under the slats, which, by means of the cranked lever, are forced down as the breaking proceeds, whilst it is at the same time dressed by the knives, which separate the shivers from it, and clean it in a very perfect manner. When one end of the handful has been thus dressed and cleaned, it is withdrawn, and the other end is fed in and cleaned in a similar manner. For flax the machine should be of smaller size than that designated; but considerable latitude may be allowed in this particular.

Having thus fully described the construction and operation of my machine for dressing and cleaning hemp and flax, I do hereby declare that, I do not intend to claim the fluted rollers, the slats, or the dressing knives in their individual capacities, as of my invention, these having been before used in machines for the same purpose, but combined together, and operating, in a manner essentially different from that herein described. What I do claim, therefore, is the general combination and arrangement of those parts substantially as above set forth; that is to say, the fluted rollers carried round by a revolving shaft, and having an independent revolution of their own, on their individual shafts, which revolution is effected by teeth taking into the teeth, or flutes on the rollers in the way described; and this I claim in combination with the dressing knives, and the movable slats, which latter are made to pass simultaneously to a greater or lesser depth within the flutes of the rollers, in the manner, and for the purpose herein fully set forth.

HARVEY LULL.

Specification of a Patent for divesting Caoutchouc, or India Rubber, of its adhesive properties, and also of bleaching the same, and thereby adapting it to various useful purposes; granted to CHARLES GOODYEAR, *city of New York, June* 17, 1837.

To all whom it may concern: Be it known, that I, Charles Goodyear, of the City of New York, in the State of New York, have invented, or discovered, a new and improved mode, or process, of divesting Caoutchouc, Gum Elastic, or India Rubber, of its adhesive properties; not at the surface merely, but for some distance below it, and, under certain circumstances, throughout its whole thickness; which process is applicable to that material, either in its natural state, or after it had been dissolved in any of the known solvents thereof, and made into sheets, or employed as a covering to cloth, or other substances; and I do hereby declare that the following is a full and exact description thereof.

I employ the various acid solutions of the metals, either saturated, or partially saturated, and with such metallic solution I wash over the surface of the caoutchouc, of which I mean to destroy the adhesive property; or instead of washing the surface of the caoutchouc, I dip it, or the article coated with it, into such a solution. If the article is cloth

coated on one side only with the solution, it is necessary, in general, to protect the uncoated side from the action of the acid solution, more especially when the more corrosive acids are used; the cloth may, in this case, be united together at the edges, and at the ends, so as to form a sort of bag, capable of being dipped into the metallic solution without its interior being brought into contact therewith.

The metallic solutions are not, by any means, equally effective in destroying the adhesiveness of the caoutchouc; the stronger acids being in all cases preferred, as being perfect in their action; nor is it indifferent what kind of metal is employed. The strong nitric acid, undiluted, is that which I in general prefer; and among the metals, I prefer either copper or bismuth, forming a nitrate of copper, or a nitrate of bismuth, as the full effect is produced by these solutions in from one to five minutes. After the action is thought to be complete, the article acted upon is to be washed with water, so as to remove the whole of the acid solution, and it will be found that not only the surface of the caoutchouc will resemble that of a soft cloth, but that this surface may be worn off to a considerable depth, and the new surface not manifest the slightest tendency to adhesiveness; it is indeed so far altered in its properties as to resist, to a considerable extent, the action of those menstrua by which it is ordinarily dissolved; it may, for example, be washed in spirits of turpentine, or in the oil of sassafras, without being rendered tackey; and it will equally resist the action of solar or of artificial heat, under all ordinary temperatures.

I have thus fully described what I believe to be the best modes of carrying my discovery into effect, by the use of metallic solutions, and have said that they are not equally efficacious; some of them, I am well convinced, would not answer the purpose at all, as the acetate of lead, for example, and probably all the solutions of metals in the vegetable acids; and there are some which will produce the effect in a less perfect manner than the nitrates which I have named, or which will require a much longer time for their complete action; but these are differences which it is not necessary, or possible, to particularize; neither is it essential to a full knowledge of the means which I have adopted to produce the intended effect. I have also spoken of dipping the article to be acted upon into a metallic solution, or of washing its surface therewith, but other modes may be devised of producing the same effect by means substantially the same. I have sometimes covered the surface of the caoutchouc with the metallic powder known by the name of bronze, and have afterwards washed it over with nitric acid, which has produced the same effect as the washing it with, or dipping it in, the metallic solution, such a solution being in this case immediately produced by the action of the acid upon the metal.

It is a common practice to add some of the absorbent earths, or some pigment, to the dissolved caoutchouc, and when this is done the metallic solution may be readily made to operate to a greater or less extent throughout the whole mass of a sheet of considerable thickness.

Instead of the process above described, or preparatory to it, I combine the caoutchouc with quick lime, as I have found this earth preferable to either of the others in fitting the sheet caoutchouc to be acted upon throughout its whole thickness by the metallic solution; but besides this, the lime has the property of bleaching the caoutchouc, and of giving to it a surface and texture adapting it to the receiving impres

sions from copper plates, or by other modes of printing, rendering it, either alone or when used as a coating for cloth, applicable to the purpose of printing charts, or other devices. The caoutchouc, so prepared with lime, will, however, be rendered adhesive by the action of heat, or of solvents, unless the metallic solutions be applied to it; in which case much of the whiteness communicated to it by the bleaching property of the lime will disappear. I, however, view my discovery of the action of lime, in the way in which I have applied it, as of great importance, and therefore proceed to point out the manipulation which I have found necessary to its successful use.

I slake a portion of the finest quick lime, and then mix and agitate it with so much water, as that it shall not be thicker than milk, when on allowing it to stand at rest, all the coarser particles contained in it will rapidly subside; the upper portion, containing the finer particles, is then to be poured off, and the fine lime allowed to subside, the water left on the surface of this being then poured off, it is obtained in a state fit for incorporation with the caoutchouc when in that form of thick paste into which it is brought by the manufacturer preparatory to its being rolled into sheets.

What I claim as my invention, and wish to secure by letters patent, is the destroying of the adhesive property not only of the surface of caoutchouc, gum elastic, or India rubber, but also to a considerable extent below the surface, whether the same be in sheets unconnected with cloth, or other substances, or when used as a coating therefor, by the application thereto of an acid solution of the metals, substantially in the manner set forth.

I also claim the manner of preparing and incorporating lime with the caoutchouc paste, for the purpose of bleaching it, and giving to the sheets formed of it a colour and texture adapting it to receive printed impressions, and rendering it applicable to various other purposes, either without or with the treatment by the metallic solutions, as herein set forth.

I further claim, as an entirely new manufacture, the sheet caoutchouc prepared by the within described process of treatment by the metallic solutions, as herein described; as it is thereby so essentially changed in its properties as to bear but little resemblance to such articles as have, heretofore, been manufactured out of the same material, and is rendered applicable to a variety of new purposes hitherto unattempted, or attempted without success.

CHARLES GOODYEAR.

Progress of Practical and Theoretical Mechanics and Chemistry.

*Alexander's Electric Telegraph.**

A model to illustrate the nature and powers of this machine, was exhibited on Wednesday evening at the Society of Arts in Edinburgh. The model consists of a wooden chest about five feet long, three feet wide, three feet deep at the one end, and one foot at the other. The width and depth in this model are those which would probably be found suitable in a working machine; but it will be understood that the length of the machine may be a hundred or a thousand miles, and is limited to

*Vide Report of the Committee on Professor Morse's Telegraph, page 106.

five feet in the model merely for convenience. Thirty copper wires extend from end to end of the chest, and are kept apart from each other. At one end (which, for distinction's sake, we shall call the *south* end) they are fastened to a horizontal line of wooden keys, precisely similar to those of a piano forte; at the other, or *north* end, they terminate close to thirty small apertures equally distributed in six rows of five each, over a screen of three feet square which forms the end of the chest. Under these apertures on the outside, are painted in black paint upon a white ground, the twenty-six letters of the alphabet, with the necessary points, the colon, semicolon, and full point, and an asterisk to denote the termination of a word. The letters occupy spaces about an inch square. The wooden keys at the other end have also the letters of the alphabet painted on them in the usual order. The wires serve merely for communication, and we shall now describe the apparatus by which they work.

This consists at the south end of a pair of plates, zinc and copper, forming a galvanic trough, placed under the keys; and at the *north* end of thirty steel magnets, about four inches long placed close behind the letters painted on the screen. The magnets move horizontally on axes, and are poised within a flat ring of copper wire, formed of the ends of the communicating wires. On their north ends they carry small square bits of black paper, which project in front of the screen, and serve, as *opercula* or *covers* to conceal the letters. When any wire is put in communication with the trough at the south end, the galvanic influence is instantly transmitted to the north end; and in accordance with a well known law discovered by Oersted, the magnet at the end of that wire instantly turns round to the right or left, bearing with it the *operculum* of black paper, and unveiling a letter. When the key, A, for instance, is pressed down with the finger at the south end, the wire attached to it is immediately put in communication with the trough; and at the same instant the letter A at the north end is unveiled, by the magnet turning to the right, and withdrawing the *operculum*. When the finger is removed from the key, it springs back to its place: the communication with the trough ceases; the magnet resumes its position, and the letter is again covered.

Thus by pressing down with the finger, in succession, the keys corresponding to any word or name, we have the letters forming that word or name exhibited at the other end—the name Victoria, for instance, which was the maiden effort of the telegraph on Wednesday evening. In the same way, we may transmit a communication of any length, using an asterisk or cross, to mark the division of one word from another, and the comma, semicolon, or full point, to mark the breaks in a sentence, or its close. No proper experiment was made while we were present, to determine the time necessary for this species of communication; but we have reason to believe, that the letters might be exhibited almost as rapidly as a compositor could set them up in types. Even one-half or one-third of this speed, however, would answer perfectly well.

Galvanism, it is well known, requires a complete circuit for its operation. You must not only carry a wire to the place you mean to communicate with; but you must bring it back again to the trough. Aware of this, our first impression was, that each letter and mark would require two wires, and the machine in these circumstances having sixty wires

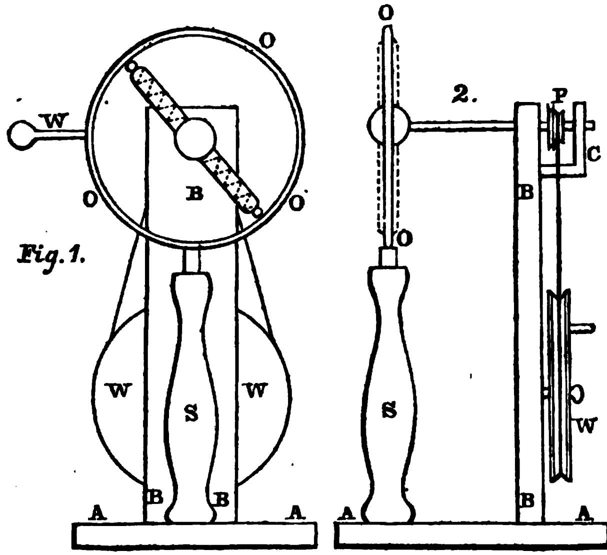
instead of thirty, its bulk and the complication of its parts would have been much increased. This difficulty has been obviated, however, by a simple and happy contrivance. Instead of the *return* wires extending from the magnet back to the keys, they are cut short at the distance of three inches from the magnet, and all join a transverse copper rod, from which a single wire passes back to the trough, and serves for the whole letters. The telegraph, in this way, requires only thirty-one wires. We may also mention, that the communication between the keys and the trough is made by a long narrow basin, filled with mercury, into which the end of the wire is plunged when the key is pressed down with the finger.

The telegraph, thus constructed, operates with ease and accuracy, as many gentlemen can witness. The term *model*, which we have employed, is in some respects a misnomer. It is the actual machine, with all its essential parts, and merely circumscribed as to *length* by the necessity of keeping it in a room of limited dimensions. While many are laying claim to the invention, to Mr. Alexander belongs the honour of first following out the principle into all its details, meeting every difficulty, completing a definite plan, and showing it in operation. About twenty gentlemen, including some of the most eminent men of science in Edinburgh, have subscribed a memorial stating their high opinion of the merits of the invention, and expressing their readiness to act as a committee for conducting experiments upon a greater scale, in order fully to test its practicability. This ought to be a public concern. A machine which would repeat in Edinburgh words spoken in London, three or four minutes after they were uttered, and continue the communication for any length of time, by night or by day, and with the rapidity which has been described—such a machine reveals a new power, whose stupendous effects upon society no effort of the most vigorous imagination can anticipate.—*Scotsman.* Lond. Mec. Mag.

Brilliant Electrical Experiments, well calculated for the Lecture Table.

The first of these experiments which we shall describe is made by the electrical machine and the apparatus represented in figs. 1 and 2, the former being a front, and the latter a side elevation.

A A is a stout rectangular mahogany board, which is the base of the instrument. B B B is a vertical piece of similar board, the lower end of which is firmly fixed in the base. Near to the upper end of this vertical piece is a crutch C, fig. 2, which, together with the main upright B B carry a spindle with its pully P. The spindle and pulley are put into rotatory motion by means of the wheel W W, and its band. The farther end of the spindle terminates in a hollow brass ball, into the opposite sides of which, and at right angles to the axis of the spindle are cemented two glass tubes spirally spotted with tin foil as seen in fig. 1. The outer end of each tube terminates with a small brass ball. By this arrangement the spotted tubes can be put into rapid rotation in a vertical plane. S is a glass pillar surmounted by a brass socket terminating upwards in a screw. On this pillar is screwed the ring o, o, o, made of stout brass wire. The inner diameter of the ring must be a little greater than the distance between the outer surfaces of the balls terminating the spotted tubes, in order that the latter may rotate within the ring without touching.



The axis of motion is in the centre of the ring and perpendicular to its plane. A horizontal wire *w*, terminating with a brass ball is screwed to, and projects from, one side of the ring.

When an experiment is to be made with this apparatus, the ball *w*, is to be brought close to the farthest extremity of the prime conductor of an electrical machine, in good order; or to a ball proceeding from the conductor: and in this position the base-board is to be screwed firmly to the table, in the usual way, with clamps.

When the machine is at work, sparks will pass from the prime conductor to the ball *w*; and again from the inner side of the ring to one or both of the spotted tubes, which will thus be brilliantly illuminated, especially if the spindle be touched with the hand, or connected with the cushion by a copper wire. Let now the wheel W W be gently turned; the spotted tubes will still be illuminated; but instead of showing stationary spiral lines of fire, they will now exhibit the most pleasing spectacle ever beheld in the whole range of electrical illuminations, whose fantastic forms will undergo a variety of changes with the speed of the wheel; and when the velocity is considerable, the optical illusion creates ideas of a complete disc of electrical light.

This splendid experiment is susceptible of much pleasing variation. If instead of having the tubes cemented into the central revolving ball they be fastened to it with screws, in the usual way of screwing balls on the extremities of wires; they may easily be removed and replaced by other devices, such as tubes of coloured glass spotted in the same manner: or by slabs of plate glass, spangled in the usual way and varnished with different colours. In this way a disc of any coloured light may be exhibited; or the luminous disc may be composed of concentric annular portions, each of a different colour. If, for instance, the faces of two revolving slabs of glass were each divided into three equal portions by lines perpendicular to their edges, and that the inner portion be var-

nished yellow, the middle red, and the outer portion blue, each portion could form an annulus of its own colour, and the whole would fill up the whole disc. In all experiments with this apparatus, however, the disc, whatever colour or colours it may exhibit, will necessarily appear annular, because of the central brass ball; which, in a darkened room, is a complete black speck.

By this apparatus, differently coloured pieces of glass may be made to combine the light they transmit; and the composition of colours displayed in the most splendid manner.

Sturgeon's Annals of Electricity.

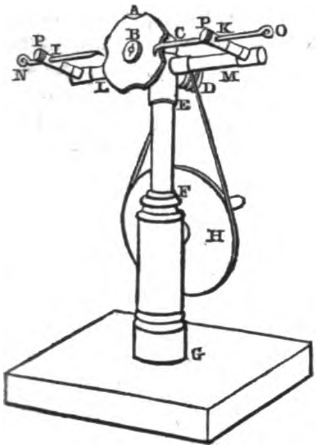
Description of an Economical and powerful sustaining battery. George H. Bachhoffner.

A piece of thin sheet copper is coiled up into the form of a cylinder, and retained in that position by fine copper wire. The size I usually employ is that of 4 inches by 2½; it is then to be placed in a small bladder, which is secured round the same by pack thread, leaving the top open, the membrane forming the bottom of the cylinder; a piece of zinc is coiled up in a similar manner, having previously soldered a copper wire to each, to form the connexion, and the battery is completed. To excite it, place it in any convenient vessel; I usually employ a jelly-pot, and pour into the copper cylinder a saturated solution of the sulphate or any other salt of copper, and outside the same and in contact with the zinc, must be placed another solution, it matters but little of what nature: one of common salt I find to be as good as any that I have tried, and it has the advantage of being always at hand and costs but little, the latter appearing to act as a conductor only; if the battery is required to be kept in action for two or three days, a few crystals of the salt of copper must be placed in the solution of the same.

From this rough statement, it is evident how cheaply an efficient battery may be obtained, and at how little cost it may be repaired when the zinc is destroyed. With an arrangement of six of these batteries, water is rapidly decomposed, metallic wires fused, and brilliant combustion of the charcoal points is obtained.. Ibid.

A Galvanic Shock-multiplier, by the Rev. N. S. Heineken.

A is a thin wheel of copper having four or more circular indentations at equal distances in its circumference. It is fastened by a nut at B to a spindle which passes through the brass tube C, and has at its other end a pulley D. The tube is insulated by means of the glass pillar E F, fixed into the wooden support F G, and by this attached to the base. H is a wheel by turning which the pulley D and disc A revolve. I K two brass arms attached by mountings to glass tubes at L and M, and by them insulated and fixed also to C E. These two brass arms hold the copper wires N O by means of the screws P P. The wire N has its end formed into a slight spring, so also has O. That at N touches the



copper disk A only where the circumference is entire; that at O always presses lightly on the face of the disk. The mode of operation of the apparatus will be sufficiently obvious. If a wire having a moist sponge be attached to one extremity, while the other is connected with one of the poles of a battery, and the hand grasp the moist sponge, and if the other pole of the battery be connected by a wire with N, the other hand grasping a second sponge, and connected with the wire O, a rapid succession of shocks will of course be experienced during the revolution of the disk A, in consequence of the interruptions which are occasioned in the circuit by the indentations in its circumference. The application of the instrument in various experiments, particularly those on the dead body, will be readily suggested.

I will not trespass further on your space than to state that the figure is in size one third of that of the instrument; that the copper disk and wires are amalgamated to ensure good contact; and that by a little alteration the apparatus may be employed for the rapid changing of the poles of a battery in electro-magnetic operations.

Lond. & Edin. Philos. Mag.

Friction of the Air.—Spinning of a top.

Mr. R. Roberts, of Manchester, stated at the British Association, that in 1824 he contrived a machine to enable him to ascertain the amount of friction, but without reference to the resistance of the atmosphere, and he found that as the velocity increased the friction rather diminished. He was convinced, however, that the resistance of the atmosphere should be taken into consideration, and in proof, he stated that on one occasion, he was on the Manchester Railway in a hurricane, blowing in the direction of the railway, and so violent, that the power of the wind was sufficient to move the carriage even without steam. In this way he passed on at such a speed as to completely neutralize the effect of the hurricane—the effect generally was that of a calm. The observation of the President on the pendulums of astronomical clocks, reminded him of a curious circumstance which had come, some years since, under his observation, and was another proof of the resistance offered, under certain circumstances, by the air. Having made a top, which spun for forty-three minutes, he was requested to make another for a friend—this he did, and to give it a handsome appearance he had it lacquered, and then found it would spin only seventeen minutes; he accordingly removed the lacquer, and it then spun for thirty-seven minutes.—Mr. Hawkins, in confirmation, observed, that inconvenience having been experienced from the resistance of the air on a fly wheel, he had greatly diminished it by reducing the surface of the revolving bodies.—Mr. Hardman Earle said, he remembered, that during Dr. Lard-

ner's experiments, at one or more of which he was present, the steam was blown off, and he mentioned several facts, shewing the great irregularity in the performance of the same engine under circumstances apparently similar.—Dr. Lardner remarked, in conclusion, that he was convinced that the amount of friction could not be much greater than that now deduced, since the adhesion was found to be within a very small fraction of the theoretical adhesion.

Mr. Hawkins mentioned, at the British Association, that in the same individual there was frequently a great difference between the left and right eye; he knew a case where the focus of one eye was thirty-six inches, and that of the other only three.

Dr. Lardner corroborated Mr. Hawkin's statements, and gave the instance of Professor Airy, who had found that he was differently short-sighted in different directions; in fact, that his eye partook of the character of a spheroid, not of a sphere, and he accordingly got glasses ground on a spheroid, which perfectly suited him. Lond. Mec. Mag.

Browning Gun Barrels.

Mr. Ettrick submitted to the Section of the British Association, a paper on browning gun barrels. After various experiments, Mr. Ettrick discovered that the process consisted wholly in procuring a *permanent* peroxide of iron, and then colouring such oxide. He had procured not only all shades of brown, but a perfect black, by mixing 1 part of nitric acid with 100 parts of water, and applying this to the barrel with a rag moistened with it. It is material that the rag should be only so much wetted as to damp the iron, for if the fluid be allowed to stream the oxidation will be unequally performed. It is also material that the barrel should be well smoothed and polished, and all greasiness removed by chalk before the browning commences, otherwise a bright brown is not attainable. The barrel, after being wet, should be placed for an hour or more in a window on which the sun shines, and when this process has been thrice repeated, the superfluous rust must be removed by a scratch brush consisting of a quantity of fine iron wire tied up into a bundle. This process being repeated eight or ten times, the barrel will have acquired as good a brown as it frequently receives from the common gunsmiths; but to do away with the disagreeable rusty appearance, it is necessary to proceed to colour the oxide, which Mr. Ettrick accomplishes by dissolving one grain of nitrate of silver in 500 of water, and applying this solution like the browning liquid. The number of repetitions of the nitrate of silver water would depend on the shade of brown required, but Mr. Ettrick found from one to five or six amply sufficient. The barrel is to be placed in the sunshine to obtain a dark colour. The last process was to apply the scratch brush freely, though lightly, and then polish the whole by bees' wax. Mr. Ettrick had, since the date of his own invention, discovered the process used by workmen generally, and long kept secret, but by the plan described, a much finer brown is attainable than that gained by the trade.

Lond. Mech. Mag.

Extracts from French Journals. Translated for this Journal by J. Griscom.

Discovery of Arsenic in a human body, taken up three years and a half after burial. By Ossian Henry, Chemical operator of the Royal Academy of Medicine.

The body of a woman which had been buried at the town of Sens three years and a half, was taken up in consequence of renewed suspicion that she had been poisoned by Arsenic. The exhumation was performed with due formality, the head and limbs were removed and the trunk was encased, legally sealed, and sent to Paris for examination. On being opened the body was found to be in perfect preservation, which was ascribed to the dry sandy soil in which it had been buried. A slight odour of rotten wood, owing to pieces of the coffin which accompanied it, was the only perceptible effluvium, while the brown bistre colour of the skin gave it the appearance of a mummy. The viscera had become hardened or corneous, and were so condensed and confounded into a membranous leafy mass as to be scarcely distinguishable from each other. The liver was sufficiently distinct; it had a waxy consistence and a deep brown colour. After a due anatomical examination, the mass of vessels was taken out, freed from the brown sandy powder dispersed through it, and the trunk was returned to Sens to be replaced in the grave.

Although the death was imputed to an arsenical compound, nothing was omitted relative to the presence of other poisons; but the result of this enquiry being completely negative, the attention of the operators was confined to the evidence of the presence of arsenic.

The detached mass was divided very carefully by a scalpel into fine shreds or strips;—these were boiled during an hour, in two successive portions of distilled water, each acidulated by half an ounce of very pure hydrochloric acid, in order to promote the solubility of the arsenite or arseniate of lime which the body might contain, in consequence of the reaction, which had supervened during the long time in which it had been in the ground. The boiled mass was thrown upon a filter of clean linen, and the brown liquid thus obtained, was exposed to the air until the next day. It was then found to be covered with a pretty thick scum of solid fat which was very easily separated.

The clear, brownish, acid fluid, thus obtained, was partly neutralized by pure ammonia, and a current of very pure hydrosulphuric acid was directed through it and kept up for a long time. The gas very soon gave rise to an abundant production of brownish magma, which in the course of forty-eight hours, was completely precipitated. The clear fluid, which was easily decanted from it, gave by analysis nothing more than a small portion of salts of no importance, some phosphate of lime, and a peculiar brown animal matter.

The precipitate was collected upon filtering paper (previously purified by hydrochloric acid and distilled water) and washed with care. In it was to be found the arsenic if any existed, in the form of sulphuret. To clear the precipitate of the brown matter, it was treated repeatedly with very dilute ammonia; but the whole of it being thus dissolved, the new liquid product, of a brown colour, was evaporated to dryness by a heat cautiously regulated. The residue was a dark brown, dry, friable substance,

which, put upon charcoal, gave out an empyreumatic, animal odour, which was followed by the smell of garlic, decidedly manifest.

The dry substance being separated into two equal parts, one of them, A, was triturated with alcoholised potash and carefully dried until it became pulverulent. Mixed with black flux and exposed to the blow pipe in a narrow tube, thick, fuliginous, empyreumatic vapours were given off, and a volatile product gathered in the narrow part of the tube, forming a shining metallic ring of a steel grey, and which proved to be metallic arsenic.

The other part of the brown product was mixed with pure nitrate of potassa and strongly calcined in a new porcelain capsule, until the white residue was entirely deprived of animal matter. This was dissolved in distilled water and exactly neutralized by very pure nitric acid. The test of nitrate of silver, then threw down a very abundant *precipitate of a brick red colour*, consisting of *arseniate of silver*.

This salt, washed and dried, produced with the blow pipe and black flux as in the former case, a reflective ring of metallic arsenic. The product of these two processes amounted to seven or eight grains of the metal.

That nothing might be neglected to prove the existence of the poison, we placed a quantity of it in a long open tube, and holding it slightly inclined over a lamp, the metal was speedily oxidised by contact with the air, and yielded a white lameller crystallization. This was boiled in distilled water and the solution was precipitated.

1. Yellow,—by nitrate of silver.
2. Green,—by ammoniacal sulphate of copper.
3. In Yellow flocculi, soluble in ammonia, by sulphuretted hydrogen.

All doubt is thus removed of the existence of arsenic in this body, and that it was to this substance that the death of the individual must be ascribed. In publishing the account, we do not pretend to exhibit a peculiar case, but from the very considerable portion of the poison which we were able to separate, it was thought there might be some benefit in making it known. The example confirms those previously established, and it may afford consolation to humanity, by proving that criminals are not sure of impunity because the earth has for a long time concealed their victims.

Jour. Pharmacie 1837.

Note by the Translator.—The results of the analysis described in the foregoing paper, are perfectly satisfactory as it respects the evidence of the existence of arsenic. Had the experimenter been aware of the method of detection by means of the simple and elegant little apparatus, described by James Marsh (Vide Jour. Frank. Inst. Vol. XVIII, p. 338) they might easily have given an additional proof of the presence of the metal. This method removes also one source of doubt which sometimes arises from the carbonaceous matter contained in the flux, which may of itself produce a ring in the tube which has much the appearance of a metallic surface, though it consists only of shining charcoal. The very small quantity of material, which this little instrument will operate upon, as well of metal which it will detect, is another strong recommendation to its adoption. We would propose, in the use of it, the substitution of a small plate of clear mica in lieu of the glass, which, as the author admits, often breaks with the heat.

Recipe for an Alloy in imitation of Gold.

An alloy is made in Germany, (Munich,) of zinc and copper, called *Chrysorin*, on account of its perfect resemblance to gold of twenty carats. This quality depends on its containing the exact proportion of fifty-one parts of zinc, to one hundred parts of copper; for if, by a heat too powerful or too long continued, a portion of the zinc becomes volatilised, nothing but common brass is produced, without lustre, containing fifty parts of zinc and one hundred of copper. The greatest precautions therefore are requisite in the fusion of the two metals. They begin by putting into the bottom of the crucible one-third of the requisite quantity of zinc, and over it all the copper which is covered with a vitreous flux. This is heated in an air furnace until the copper is well melted, which is known by its assuming a mirror-like surface under the flux. The rest of the zinc is then added in small pieces.

Jour. de Connais. Usuelles.

On the various uses of Steatite.

Steatite is a kind of soapy marl, or talc, sometimes white, at others green, or grey, and more rarely red or yellow. Its sp. grav. is from 2.60 to 2.66. It is composed of silex, alumine, magnesia, oxide of iron and water, but it varies in different localities. It is very common in Germany, in Cornwall, and it exists also in the western part of France. As it requires a very high heat for fusion, and is cut or wrought with great facility, very good crucibles can be made of it, which fire hardens and litharge penetrates very easily. It is employed for moulds in metallic castings. It is used in England in the manufactory of porcelain. M. Vilcot of Leige, has made a great number of trials to ascertain whether this substance can be employed by Lapidaries; he has made Cameos of it, to which he has given a fine brilliancy by heat, and such a degree of hardness as to give sparks, with steel. He has succeeded in colouring them yellow, grey, and milk white, by the addition of various solutions. By polishing them on stone, he has given them all the splendour of agate, and has obtained some pieces which resembled onyx, but the fire very soon obliterates the veins, which cannot be reproduced. Having a great affinity for glass, steatite, reduced to very fine powder, answers very well when mixed with other colours, for painting on glass. It is used also as a kind of sympathetic pencil for writing on glass, leaving no traces when the glass is rubbed with woollen cloth, but becoming again visible by breathing freely upon it, and disappearing again as the glass becomes dry. Workers and embroiderers of silk prefer it to chalk for tracing, because it is more durable and does not affect the colours of the stuff. As steatite has the property of uniting with oils and fatty substances, it enters principally into the composition of the balls used for cleaning silk and woollen stuffs. It is the basis also of some pigments. It gives a fine brilliancy to marble, to serpentine and gypseous stones. Mixed with oil, it is used to polish glass and metallic mirrors. If newly prepared leather be powdered with it and allowed to dry, it gives it, when rubbed with horn, a very fine lustre. Steatite is employed for glazing paper, by being spread over it in very fine powder, or better by being mixed with the colouring matter, and then glazing by rubbing with a brush. The powder of steatite, from

its unctuosity is one of the substances which give the easiest play to vices and screws, and diminish friction in wheels. Mixed with tallow it furnishes a very favorable material for preserving machinery.

Steatite is easily cut with a saw, turned in a lathe, and smoothed with a plane. It may therefore be worked into any shape, and afterwards if necessary be rendered very hard. When the artist has finished his design he places it in a covered crucible, surrounds the crucible with charcoal in a furnace, raises the heat gradually, keeps it for two or three hours in nearly a white heat and allows it to cool slowly, When it comes out, it is so hard as to strike fire with steel and to blunt the best files.

White specimens of steatite acquire a milk white by exposure to heat; those which are coloured assume a grey or reddish tint, but they may be variously coloured by the aid of oily, alcoholic, acid or alkaline solutions. Colours that dissolve in amber varnish, such as verdigrise, ochre, &c., colour steatite, when heated by charcoal. Colours dissolved in spirits of turpentine are the most lively. Solutions of carthamus (saffron flower) gamboge, campeachy wood, dragons blood, &c., in spirits of wine, colour steatite by steeping it in them several hours. Solution of gold in aqua regia, gives a purple colour, of a shade depending on its strength. Muriate of silver colours it black when aided by sulphuric acid. Sulphate of indigo—a greyish blue. If steatites, coloured by nitro-muriate of gold, or muriate of silver, be exposed to a bright flame, it assumes the metallic colour of gold or silver.

When the stone is heated, colours dissolved in acids are rapidly and finely attached to it, and hence a cameo ground, of any particular colour, is easily obtained. Sulphuric acid produces more effect than nitric and muriatic. Oxalic acid may be successfully employed. Colours dissolved by alkalies, and especially indigo, serve to colour steatite. In general these colours penetrate about one eighth of a line into the body of the stone. We are indebted to M. Moy for these researches.

When the stone is baked, it is polished, as usual, with emery, tripoli, or tin putty. It acquires much brilliancy, resembling agate, jasper, calcedony, &c. It is easy from these facts to infer, that the engraver may avail himself of this substance, on account of its softness, since he may perform upon it in one day as much as he could do upon hard stones in a week; and when it has passed through the fire, his work acquires a hardness and durability almost unlimited.

Jour. des Conn. Usuelles.

On the Constructions of Panoramas.

Panoramas, invented by Robert Fulton, have undergone numerous modifications, especially in France, by the invention of the diorama and neorama.

The problem consists in making a cylindrical picture, with a circular base, on which all the objects which the artist can discover, from the point of view that he has selected, may be painted in due perspective. The great art is afterwards to enlighten and animate them with the most appropriate colours.

For this purpose a rotunda is constructed exactly circular, fifty-eight feet in diameter, and twenty-three in height. The interior of the walls is hung with cloth regularly stretched over it. After giving the cloth a

ground or priming, as in common pictures, there is traced upon it a number of squares, corresponding to those on a sketch previously drawn on paper, whose dimensions are as one to twelve. These sketches are transferred to the cloth, square by square, and are finished in oil or water colours, at the pleasure of the artist.

The spectators are placed on an amphitheatre, erected in the middle of the rotunda, which is ascended by a winding staircase. The height of it is such that the eye of the observer is on a level with the horizon of the picture. An iron gallery, concentric with the rotunda, circumscribes the space from which the picture is seen. The spectator in this gallery is prevented, by the edge of the amphitheatre, and a curtain which hangs from the platform, from seeing either the base or the height of the picture, which allows his imagination to indulge the idea of an immense and indefinite height and depth. This is aided by the change of aspect which he finds in going from the centre towards the gallery. The illusion is so complete that he really fancies himself transported to the very spot which the artist chose for taking his perspective.

Idem.

Machine for Washing Potatoes.

This machine is a cylinder composed of wooden rods, or rounds, fastened at the ends in circular boards. Six of these are put together so as to make a door on one side of the cylinder for putting in and letting out the potatoes. This cylinder is placed in a trough full of water, and is turned by a crank outside. It is raised out of the water by two pullies attached to its axis. The potatoes rubbing against each other and against the rods, are washed and cleaned, the dirt falling into the water of the trough.

This simple machine is very effectual, washing potatoes without allowing them time to become swelled by absorbing the water.

Ibid.

New substitute for Bell Glasses.

I have used for several years, for melons and other delicate plants, bells constructed as follows.

On a wooden hoop, fifteen or eighteen inches in diameter, I erect three segments of circles so as to form a kind of dome twelve or thirteen inches high. I paste on this frame pieces of muslin cut to fit, and give to the bell three coats of varnish made of Cheese curd . 4 ounces.
Slaked lime . . 1 drachm.
Mixed thoroughly, and add Linseed oil . 4 ounces.
The oil easily combines with the mixture, into which is afterwards incorporated whites of eggs and water, each four ounces. This varnish dries quickly. The oil prevents it from scaling, and gives to the cloth the requisite flexibility.

Plants raised under these covers enjoy a more uniform temperature than under glass. The heat is not so great in the middle of the day, but it does not fall so low in the night. The dimensions may be altered at pleasure.

Bodin de la Pichonnerie, Docteur.

Method of preserving Apartments from the Odours of a Kitchen.

Where kitchens are situated beneath a parlour or sitting room, or even on the same floor, the vapours are sometimes a nuisance. To remedy this inconvenience, a ventillator should be opened into the flue of the kitchen

chimney, near the ceiling. The draught of the chimney carries up the effluvia; or if the flue be too wide, a pipe may be attached to the opening, and carried to the top of the chimney. Ibid.

We have known, in the crowded part of a city, an odour from a neighbouring apartment, more intolerable than that from a kitchen, effectually removed by a pipe passed into the flue of a chimney.

The gas from a coal grate sometimes, on reaching the top of the chimney, falls by its superior gravity into an adjoining flue, and thence into a chamber below, where it becomes very noxious. We were informed by Dr. Hare, that, on one occasion, suspecting this to be the source of the annoyance in one of the chambers of his own house, he had an opening made in the side of the chimney above the roof, and a little below the top of the stack. Through this opening the gas then flowed without reaching the top, which completely remedied the difficulty. Tr.

To preserve Water in Casks at Sea, and in Cisterns.

Add a little black oxide of manganese in powder to the water, and agitate the mixture. The water on this addition loses its bad taste, and may be preserved indefinitely. Ibid.

Fresh Jelly for the Sick.

The difficulty of procuring recently prepared jelly, except at a very high price, and from known confectioners, may render the following acceptable to some persons in ill health. Take the half of a young and thin fowl, a quarter of a pound of knuckle of veal, and a quart of water. Put the materials in a glazed earthen pot, over a slow fire or hot ashes, and let them concoct eight hours until the fluid is reduced to less than a pint. Strain it through a fine sieve, pour the liquid into coffee cups and set them aside in a cool place. In a few hours a firm jelly of good consistence will be found. A carrot, turnip, parsnip, two beets and one half of a roasted onion, or any of those at pleasure, with a due quantity of salt, may be added to the materials before they are placed on the fire. Ibid.

On the Light obtained from Air and Oxygen, by Compression. By M. Thenard.

The author ascertained that chemists had erred in supposing that all bodies, and even gases, became luminous by a strong and sudden compression.

M. Saissy concluded from his experiments, that oxygen when compressed gave out a bright light; air produced light, but less brilliant, but that no light whatever could be obtained by compressing either azote, hydrogen or carbonic acid.

M. Thenard, in prosecuting the examination, soon learned that the property of becoming luminous in the dark by compression, belongs in reality only to oxygen, to air, and to chlorine; but reflecting afterwards that the pistons used to compress the gases in the tubes consisted in part of leather impregnated with some greasy substance, which water moistens with difficulty, he thought that the light which appeared might proceed only from

the sudden production of a little water, or hydro-chloric acid. To determine this, he had pistons prepared of hatters' felt, or, if of leather, to the latter was attached a cylinder of metal so as to cut off all communication between the leather and the gas, except in an extremely small space. The tubes were accurately ground.

Thus arranged, when care was taken not to moisten the felt or the metallic cylinder, and to clean the tube with potash, there never was any light produced; but if the felt was moist, or the tube badly cleaned, a light almost always appeared.

It was found also that in oxygen gas, with the piston moistened, inflammation took place not only in amadou, but in paper, wood, and even box wood, when perfectly dry. When impregnated with oil, they took fire more easily.

Similar trials were made with chlorine. When the paper was impregnated with very little oil, it became incandescent. Alone, neither paper nor wood succeeded, the action being either too weak or too slow.

It was found impracticable to inflame a piece of pine wood in oxygen gas at the temperature of 350° under atmospheric pressure alone; but it was inflamed at 252° under a pressure of 262 centimetres. The pressure was effected by a column of quicksilver in a bent tube, the part containing the fragment of wood being plunged in a basin of mercury placed over a furnace. By employing a small portion of fulminate of mercury, which explodes at 145° C. it was proved that carbonic acid gas had its temperature raised by compression. The powder exploded in carbonic acid, azote, and in hydrogen, at the same temperature as in the air, when heated to the same extent by the compression of the gases. At 205° the glass was blown to pieces by compressing them over the powder.

The principal results of M. Thenard are thus stated:

1. No gas becomes luminous of itself by ordinary compression in a pneumatic fire pump.

2. When a gas is compressed by hand as forcibly as possible in a glass tube, the temperature is raised thereby above 205° Cent. = 400 F. So that powders which decompose only at that temperature, detonate in azote, hydrogen, and carbonic acid subjected to a sudden and forcible compression.

3. Paper and wood are inflamed in oxygen by a strong compression.

It is the same with paper in chlorine, when impregnated with a little oil.

4. There is every reason to believe that if gases may become luminous by pressure, it must be only at a very high temperature. Ann. de Chimie.

Physical Science.

On the formation of Hail. By M. De la Rive.

Electricity, whose presence in the formation of hail is rendered probable by the thunder and lightning which always accompany and characterize storms, has long been regarded as playing an important part in this phenomenon, as in almost all other meteorological occurrences. Volta, especially, by means of the opposite electricities with which he supposed the clouds which were placed the one over the other were charged, explained the augmentation in the size of the hailstones, which, according to him, passed from one of these clouds to the other,

as light bodies situated between two jars filled with opposite electricities, would be alternately attracted and repelled between them.

In thus frequently traversing the humid atmosphere which separates the two clouds, and in slightly penetrating the clouds themselves, he maintained that each hailstone condenses upon itself an increasing quantity of water, which is congealed, thus forming the concentric layers which are observed in its structure; till finally becoming too heavy, it could no longer be sustained among the clouds, and fell upon the earth in a more or less inclined direction, according to the strength of the wind. It is to this tossing to and fro between the two clouds, and to the dashing of the hailstones against each other, that he ascribed the peculiar noise which is heard in the air some time previous to the descent of hail, and which has been compared to the noise which the quick and violent shaking of a sack full of nuts would produce. As to the formation of the nucleus of the hailstone, Volta attributed it to the great degree of cold produced by the evaporation which takes place at the upper surface of a cloud, the rapidity of which is increased by the direct effect of the solar rays which strike upon the cloud, and are absorbed by it.

The theory of Volta was attacked in a very powerful manner by M. Arago, in a very interesting article, which appeared in the Annuaire of the Board of Longitude for 1828. After confirming some objections which had previously been advanced by M. Bellani, the illustrious Frenchman suggested many others. How, for example, can it be admitted, that the great evaporation produced by the heating of the cloud by the action of the solar ray can be the real cause of greater cold, when this evaporation takes place only in virtue of the larger quantity of heat which is supplied to the liquid? Who, again, can conceive that the electrical power exercised by bodies so light as the clouds can sustain and neutralize the action of the weight of the hailstones, amounting sometimes to half a pound? or, finally, how can we suppose that two clouds can continue so strongly electrical that they can move heavy masses when they are so near each other, and separated only by an extremely humid stratum, through which the electricity might freely pass from the one cloud to the other?

Such are some of the objections to which the theory of Volta is liable, and which M. Arago points out in the article just referred to. It was the difficulties in which the theory is involved, that led the *Academie des Sciences* in the year 1830, to appoint the best explanation of the phenomena of hail as the subject of the great prize which fell to be delivered in 1832. The conditions on which it was to be conferred were severe. The competitors were to supply a theory supported by direct experiments, and upon varied observations made, if possible, in the very regions in which the hail was formed, and which might replace the vague hypothesis with which we have been compelled to be satisfied up to the present time. The essayists were also recommended to avail themselves of all the accurate information which had hitherto been collected on the radiation of caloric, on the temperature of the atmosphere at different elevations, on the cold produced by evaporation, and upon electricity. &c.; finally, they were required, whilst treating of the formation of hailstones, to follow out the consequences of the theory they should adapt to its numerical applications, regarding the physical con-

stitution of these hailstones, also respecting the enormous bulk they sometimes acquire, and as to the season of the year, and the times of the day in which they were most commonly observed. But in 1832 the prize was not conferred, because none of the memoirs presented were considered worthy of the honour; and the *Academie* again appointed this subject as the question for competition for the year 1834. Again, however, none of the essayists fulfilled the conditions proposed, the prize continued unadjudicated, and from that time, we believe, the subject has been entirely withdrawn.

It is under these circumstances that M. Lecoq, without aiming at the prize, appears to have complied, if not with all, yet, doubtless, with the most difficult of the required conditions; inasmuch as he has produced observations which were made in the very regions in which the hail was formed, and which besides, as we shall presently see, are abundantly calculated to throw light upon the theory of the phenomenon, and especially to demonstrate by facts the truth of the objections previously offered against the theory of Volta. We shall now allow M. Lecoq to speak for himself, and shall then conclude this article by some considerations on the phenomenon of hail, as influenced by electricity.

The year 1835 was quite remarkable for the number and intensity of the storms which prevailed in the south and middle of France. Electrical clouds rested permanently above the high mountains of Auvergne, and if sometimes the heat of the sun succeeded in dissolving them, it was only for a few hours, and very rarely for a whole day. The clouds accumulated with rapidity, the thunder rolled in the distance, a tempest announced the storm, and the rains descended in torrents. Violent hail showers had already destroyed the harvest in the district of the Puy-de-Dome, and every day brought with it fresh disasters.

On the 28th of July the sun rose from an azure sky, no cloud appeared on the horizon, no vapour floated in the atmosphere, so that a beautiful day was anticipated. At 10 A. M. the heat became intense, and at midday it was almost intolerable, and then some thin flakes of vapour floated in the air at a great distance; the wind was north, but so feeble, that it in no degree tempered the heat. At one o'clock the wind had increased; the white and floating clouds had descended considerably, and half an hour later, covered a great part of the horizon; they had a greyish tint, which became darker and darker, till they were nearly quite black. At two o'clock they formed an immense covering over the whole of Auvergne; and it was then easy to anticipate that a frightful storm was at hand. We waited with anxiety for the issue of that majestic and terrible scene which was preparing. Silence and consternation every where reigned, speedily flashes of lightning illuminated the massive vapours which covered the old volcanoes of Auvergne, while the sun still shone upon a portion of La Limagne. We then heard a distant and low-muttering sound which resembled a kind of rolling, and almost at the same time we saw a vast cloud advance from the west to the east, pure white in some places, but principally on its edges, and of a deep grey colour in the centre; it approached with great rapidity, and seemed to be hurried forward by a violent west wind, which we had not previously felt at Clermont. This cloud was evidently underneath all the others; its borders were festooned and deeply slashed, and protuberances, in the shape of long nipples, were suspended from the lower

portion. At a quarter past two, the anterior part of this cloud had approached very near to Clermont, and the noise which we had long indistinctly heard, was now very intense; and I then very clearly distinguished a very rapid motion in the edges of the cloud; these edges seemed to me to be undulating, but in the position in which I was, what appeared to be undulations must have been the product of a very violent agitation. I then imagined that I could distinctly perceive hailstones in the edges of the cloud, and I predicted to some persons who were with me the immediate descent of hail. Accordingly, two minutes after having seen this whirlwind kind of motion, there was a fall of hailstones, which instantly broke all the tiles of the houses, and all the panes of glass exposed to the north and west; for the hailstones being at the same time propelled along both by the north and west wind necessarily took the mean direction.

The first hailstones which fell succeeded each other very slowly, then all at once their number increased so rapidly that in ten minutes the soil was covered with them; some drops of water escaped at the same time from the electrical cloud, and then the distant rolling sound which we had so long heard entirely ceased; and the cloud freed from its swelling appendages, was carried away by the wind; after some hours the sun illuminated, with its pale and feeble light, that scene of desolation which night was speedily about to envelope.

It is not necessary that I should describe in detail the terrible effects of these hailstones. Suffice it to say, that some branches of trees two inches in diameter were cut asunder by them; some polished stones which formed part of the cornice of houses were broken on their edges, and some phonolite slabs, which were employed instead of the tiles which cover the roofs, were broken by the shock of the masses of ice. Finally, a considerable part of the beautifully stained glass in the windows of the cathedral of Clermont was in a few minutes broken, although it had been exposed for at least four centuries without having been injured by any storm.

The hailstones fell very obliquely, so much so, that many persons were struck by them in their rooms, after they had entered, through their windows; others were surprised in the fields and were wounded, though I have not heard that any were killed. I anticipated that I should have discovered a marked rotary motion in the hailstones, but I could not convince myself of it at the moment of their fall, for they almost all broke instantly on the pavement.

The fall of the hail was scarcely over when I went, accompanied by M. Bouillet into the Botanic Garden, with the intention of examining the hailstones. Here we found many which, from having fallen upon the plants, were quite entire, and presented very remarkable forms. Their medium size was about the size of a pullet's egg, and some were as large as a turkey's. We were, however, informed that some of larger dimensions had fallen at Montferrand. Their form was an elongated spheroid, with the two extremities apparently equal: they were generally studded over with crystals, some of which still bore the shape of hexagonal prisms, terminated by six-sided prisms; but more frequently the angles had melted away, and the prisms had become cylindrical. Some of these superadded crystals projected as much as eighteen lines at the moment of their fall, and some according to appear-

ance were two inches high. Other hailstones were only rough on their surface, and presented an infinite number of small elevations, like the masses of sulphuretted iron which are found in certain clays and lignites.

The crystals were grouped at the two extremities of the great axis of the ellipsoid, which, to all appearance, were the two poles of the hailstones, and their equator, so to speak, was deprived of a large proportion of them: in all, the crystals were largest at the two extremities. The interior structure of the hailstones was nearly always the same. The centre was formed of small grains of white hoar-frost, and was opaque and fibrous; this was surrounded by many layers of transparent ice, which were sometimes so distinct that they could be counted; they increased in thickness as they approached the circumference, and they appeared harder towards the exterior than in the interior.

Their weight was not great, for the heaviest we weighed was only four ounces. However it is probable that the heaviest did not fall within our observation, for other individuals found some of them as heavy as five ounces and a half; and I have been assured that some weighed as much as eight ounces, and even as several pounds. Laying aside all exaggeration, I am inclined to believe that some amounted to eight ounces, though I much doubt if any were heavier.

Painfully distressed with the disastrous consequences of the storm, the opportunity escaped me of collecting the hail stones and afterwards analyzing the water, which I subsequently much regretted, and the more so, as persons worthy of credit have assured me, that many of them deposited a blackish residuum, which had a disagreeable smell, and that the water which was obtained on their melting had a very decided odour.

Having learned that the storm had raged in the Department de la Creuse, I suspected it might have prevailed to a still greater extent, and therefore requested M. Dejean, the Prefect of the Puy-du-Dome, to solicit information from the Prefects of the neighbouring departments, which he did with the greatest kindness.

I thus learned that the storm began at ten o'clock in the morning over the sea; the hail commenced by desolating a part of the Ile-d'Oleron, particularly the communes of St. Pierre and St. George's. The cloud then passed from the west to the east over the department of La Charente Inferieure, in which the district of Marennes particularly suffered. The communes of St. Aynant, St. Jean-d'Angle, St. Symphorien, St. Sornin, St. Just, Arvers, &c., were also visited by the storm, the hailstones varying from the size of a hazel-nut to that of a walnut.

The cloud passed over La Charente without discharging any hail; at least I have not obtained any information that it did from the Prefect of this department; but in Haute-Vienne, and exactly on the confines of La Charente, the hail fell in many places in the neighbourhood of Rochechouart. From thence, and pursuing a straight line from west to east, it crossed the department of Haute-Vienne. At noon it arrived at La Creuse, district of Bourganeuf. The communes of Faux-Mazuras, Manzac, Soubrebord, Morterolle, Vidaillac, St. Hilaire, La Pouge, and St. George's, were more or less invaded by it. The storm continuing to follow the same direction, reached the district of Aubusson, and there produced great devastation. From mid-day till two P. M. enormous hailstones fell in the communes of St. Amand, Lupersat-Ars,

St. Avit-le-Pauvre, St. Sulpice-les-Champs, La Rochelle, St. Maixent, St. Ulpimien, Maynat, Beissat, Alleyrat, St. Silvain-Letrueq, St. Aynat, La Chaussade, St. Michel-de-Vesse, Chavanat, Malleret, and Banise. At half past one o'clock the storm reached the western limit of the department of Puy-du-Dome; a quarter of an hour later, there descended upon the communes of Gelles, Proudine, St. P.-le-Chastel, St. Oure et Roure, enormous hailstones which, in a few minutes, covered the earth to the thickness of three inches. At two o'clock, masses of real ice fell upon the lava which extends behind the Puy-du-Dome, and were broken to pieces on the angles of the volcanic rocks. Shortly after the cloud passed the Puy-du-Dome, it did much damage in the commune of Arcines, and from about a quarter till half past two, it finished its disastrous course, upon Clermont and Montferrand; and thus in about four hours and a half the tempest cloud traversed a space of about ninety leagues.

In La Charente Inferieure, some communes of the district of Jonsac were visited by hail showers between three and four o'clock P. M., as some others had been at four o'clock A. M. At St. Yrieix (Haute-Vienne) there was also a fall of hail between three and four o'clock P. M.; and finally, half an hour later than that at Clermont, in the same department, the storm descended upon the communes of St. Germain, L'Embron, Ardes, St. Gervais, Collonges, Mauriat, Beaulieu, Lebrénil, Jumeaux, Auzatsur, Allier, Orsonnette, Lamonge, and Estel.

Hence we may conclude that the line of the hail was accompanied with lateral clouds, which the north wind carried generally to the south. The cloud which carried the hail was at first narrow, it then increased in size, and attained above the department of La Creuse, its greatest width; it then contracted again till it reached the middle of the department of the Puy-du-Dome, in which its extremity, cut in a straight line, presented an edge of half a league in breadth: its shape was that of a spindle, of which each truncated extremity was situated on the one side upon the Ile-d'Oleron, and on the other over Clermont, and the widest part was above La Creuse. In all the more ample accounts I have obtained, it is stated that the colour of the cloud was grey and white; that its edges revolved, that it extended from west to east, and with great rapidity, under the enormous cloud which hid the heavens from every eye. The wind also was every where the same, that is to say, there were two currents, the one placed above the other, which crossed each other at right angles, and in the direction of the four cardinal points, or from north to south, and from west to east.

The intensity of the storm went on steadily increasing. In La Charente Inferieure the hailstones were small, round, and not very numerous; their numbers and volume increased in the department of Haute-Vienne, where some of them assumed the oval form; but it was especially in the department of La Creuse and in the district of Aubusson, that the hailstones attained all their size, and that oval form which they preserved as far as Clermont; and their bulk was, to all appearance, very considerable, for the documents I have received from this department nearly all assign eight or ten ounces to them, and some as much as two and three pounds, so we are safe in concluding, that many of the larger were six or eight ounces.

It appears that the others were not covered with those long crystals

which were found in those which fell at Clermont; these latter, during their long course, were the only ones which allowed the water of the cloud which sustained them to crystallize around them.

The hail was every where of short duration, it seldom lasted for half an hour, and almost every where it was followed by rain, which, however, was not very copious.

The tempest cloud was exceedingly low when it left the department of La Creuse, for it passed along below the summit of the Puy-du-Dome, on which no hail fell, whilst a great quantity fell on the Little Puy-du-Dome, at the height of 3700 feet. Several persons who were upon this mountain at the time, were struck by the hailstones without experiencing any injury from them, although they were all studded with long and many pointed crystals. The animals which were feeding at this elevation were also assailed by these hailstones without manifesting any signs of fear, whilst some accidents happened on the road to Limoges, at an elevation of 620 feet less: the horses being hit hard, took fright, and the carriages were overturned.

The hailstones at the top of the Little Puy-du-dome were carried along with great horizontal rapidity, and a few only fell on the summit of the mountain; they passed along with a hissing noise in a stratum of air which was extremely cold.

After the storm, I satisfactorily ascertained the height at which the hail was formed, by an attentive examination of the trees and plants, at the base and on the sides of the Great Puy-du-Dome.

At a certain elevation, the leaves, though exposed to the action of the hailstones, were not much injured, and were in no degree torn; for not having acquired at that time any great vertical velocity, they struck without tearing, and so fell under the trees. Somewhat lower down, descending towards Clermont, the leaves of the trees were lacerated; lower still, the branches were broken, and we have already stated some of the devastations of which Clermont was the scene; for the hailstones had then traversed a vertical course of from 2000 to 2500 feet.

The storm of the 28th July was assuredly one of the most awful that has been witnessed for many years. During the following days numerous very heavy showers were the preludes of new storms; and on the 2d of August a part of the zone which had been destroyed by the hail of the 28th of July, was again whitened with fresh hailstones; but nothing had been left for further destruction.

It happened that on the 2d of August I was a witness, so to speak, of the formation of the storm, and of the congelation of the hailstones.

Leaving Clermont at six in the morning, I ascended the high ground which commands the town on the west. I traced the limits of the hail on the 28th July, that I might determine, by following the edges of the injured surface, the shape of the cloud which had conveyed the dreadful scourge. At 10 I reached the base of the Puy-du-Dome; the day being splendid, and the sun most powerful.

Some white clouds extended themselves over the Mount-Dore; the Puy-du-Dome stood out majestically from the azure sky. Some shepherds whom I had interrogated respecting the effects of the hail on the 28th, urged me to retreat without loss of time to the hamlet of La Barraque, if I wished to avoid the storm which, according to them, was assuredly and speedily coming to assail us. The hope of seeing, in all its details,

one of those magnificent scenes of which the atmosphere is the theatre, induced me, on the contrary, to attain, as quickly as possible, the summit of the Puy-du-Dome, and before mid-day I was seated on the top of this enormous pyramid, and extending my observations over the immense horizon. The west wind, which had prevailed all the morning, speedily brought along with it some low clouds, which passed a few yards above my head, but the sun again appeared. I then saw other clouds detach themselves from the Mont-Dore, and approach very near me, impelled by a very violent south wind, but which I did not feel till near one o'clock. When I thus saw great clouds proceeding in different directions, I could not for an instant doubt the formation of hail, and my hopes were soon changed into reality.

So long as the two strata of clouds were not superimposed on each other, there was no appearance of hail. All I noticed was, that those which came from the south, and which were the most elevated, were congregating in little groups, which seemed to precipitate themselves on each other, so forming great black clouds, so large and weighty that the wind could scarcely move them, though they nevertheless proceeded towards the north. The lower part of the cloud would then elongate itself, presenting an enormous projection, torrents of water would speedily escape from it, which inundated spaces which were very circumscribed. As soon as a large quantity of water had escaped from the cloud, it became lighter, was again carried along by the wind, and disappeared at the horizon. This phenomenon was repeated many times during the course of an hour: but by this time the west wind had collected a great number of clouds, which formed an immense curtain, extending over the whole vault of the heavens. The south wind pushed under this stratum of vapour additional white clouds, which came with great velocity. The wind became violent and very cold on the summit of the Puy-du-Dome. The lower stratum of clouds was not like the upper, uniform, but was composed of numerous coloured flocculi, which advanced in the same direction, but at unequal distances, and with different velocities. The brightest flashes of lightning illuminated them from time to time, and the thunderbolts, like furrows of light, passed from one cloud to another; sometimes an extended flash seemed even to traverse, at the same moment, the space which separates the Puy-du-Dome from the Mont-Dore. All these phenomena occurred in the lower strata of vapours, and I never saw the electric spark traverse the stratum of air which separated the two layers of clouds. I perceived the hail in the distance precipitate itself from the lower clouds and fall to the earth; I saw it distinctly at the distance of fifty yards from the summit of the Puy-du-Dome, and before my face. The cloud whence it escaped had indented edges, and exhibited in these edges a whirlwind kind of movement which it is difficult to describe: it seemed as if each hailstone was forced forward by an electric repulsion. Some escaped from beneath, others sprang out from above, so that they flew off in all directions, and would assuredly have reached the earth in many different courses, if the south wind, which was beneath the west wind, had not blown them all towards the north. After five or six minutes of this extraordinary agitation, in which the anterior edges only of the cloud seemed to participate, the hail ceased, order was re-established, the hail cloud, which had continued to advance very rapidly, continued its

route towards the north, allowing us to perceive in the distance some sprinklings of rain, which scarcely reached the earth's surface, appearing rather to be dissolved in the lower strata of the atmosphere.

I waited for a second scene similar to that which I have just described, till a prodigious flash of lightning illuminated all the lower mass of clouds, one of whose edges rested upon the summit of the Puy-du-Dome. I imagined that I was all of a sudden plunged into the most vivid light, and experienced a general uneasiness, which probably arose solely from the terror with which I was seized. I descended the Puy-du-Dome with the greatest rapidity, fearing to be hurt by the hailstones, or at least to be drenched by the storm, and I made for an asylum in a hollow grotto at the base of the Puy-du-Dôme, which had on other occasions afforded me shelter. The summit of the Puy-du-Dome was enveloped in the tempest cloud, and it would have been imprudent to have remained longer there.

[TO BE CONTINUED.]

Shooting Stars.

[From the pen of M. Arago, in the Annuaire of 1836.]

If the reader will refer to page 429 of our third volume, he will find a sketch of the first of the appearances here alluded to, with an account of their being seen in the West Indies at the time.

These phenomena, which have often been considered unworthy of investigation, and regarded simply as atmospheric meteors, originating in the inflammation of a quantity of hydrogen gas, have, in consequence of recent observations, become objects of greater attention among men of science. Previous theories limited their place in the heavens to our own atmosphere; but from observations made at Breslau, and other places, by Professor Brandes, and several of his pupils, the height of some shooting stars has been calculated at 500 English miles; and the rate at which they move not less than thirty-six miles in a second, which is nearly double the rate of the earth's motion round the sun. If a reduction be made to one-half of this rate per second, in order to allow for the illusion occasioned by the motion of the earth, the real motion would be eighteen miles per second, which, with the exception of the earth, would still be more rapid than that of any of the principal bodies of our system. In the attempts which have been made to ascertain the apparent direction in which shooting stars usually move, it has been ascertained, that although they become ignited in our atmosphere, they come from beyond it. It is singular that their general direction should be contrary to that in which the earth moves in its annual orbit; and it is much to be desired that the inferences already deduced should be corrected or confirmed by a greater number of observations. We think that the officers of the watch on board the Bonite,* should be invited, during their voyage of discovery, to note the hour of the appearance of each shooting star, its angular height above the horizon, and especially the direction in which it moves. In referring these meteors to the principal stars of the constellations which they traverse, the different questions here raised can be easily settled.

The means of accounting for the extraordinary appearance of lumi-

*A French vessel on a voyage of discovery.

nous projectiles observed in America in the night of November 12th and 13th, 1833, are not very satisfactory, unless it be assumed that, besides the planetary bodies which revolve round the sun, there are myriads of smaller bodies which only become visible at the moment when they come within our atmosphere, and assume a meteoric appearance; that these asteroids (to use the term which Herschel formerly applied to Ceres, Pallas, Juno, and Vesta) move in groups; and that they move singly also. A careful observation of shooting stars is the only means of enlightening us on this curious subject.

The shooting stars in America, to which allusion has been made, were observed in 1833. They succeeded each other at such short intervals that it was impossible to count them; and the most moderate calculations fixed their number at *hundreds of thousands*. They were so numerous, and showed themselves in so many quarters of the heavens at the same time, that the attempts to estimate them were only rough guesses. At the Observatory at Boston, their number was considered to equal one-half of the flakes which fill the air in an ordinary fall of snow. When their numbers were diminishing, 650 stars were counted in fifteen minutes, in a circumscribed part of the heavens, which did nót comprise a tenth part of the visible horizon; and these did not amount to more than two-thirds of the whole number seen, which was at least 866; and if the whole hemisphere could have been surveyed by one observer, the number seen would have been 8600, or 36,640 per hour. As the phenomena continued more than seven hours, the number of shooting stars visible at Boston was upwards of 240,000; and it should be recollected that the basis of this calculation was taken when the intensity of the phenomenon was diminishing. It was visible along the whole of the eastern coast of North America, from the Gulf of Mexico to Halifax, from nine o'clock in the evening to sunrise, and in some places in full daylight, at eight o'clock in the morning. All these meteors came from the same point of the heavens, viz. γ of Leo; and those which were seen elsewhere were the effect of the earth's movement, which caused an apparent alteration in the position of this star. The above facts are certainly very curious, but the following are not less so:—

The shooting stars observed in the United States appeared in the night of the 12th and 13th of November. In 1799 a similar phenomenon was observed in America by M. de Humboldt, in Greenland by the Moravian Brethren, and in Germany by various individuals; and the period of its appearance was also the night of the 12th and 13th of November. In 1832, in Europe, and some parts of Asia, the phenomenon was witnessed; and the date was still the night of the 12th and 13th of November. This identity of dates induces us to urge upon our young seamen the task of observing with attention the appearances in the firmament between the 10th and 15th of November. Since my report has been read to the Academy, M. Berard, one of the most intelligent officers of the French marine, has favoured me with the subjoined extract from the journal of the brig Loiret, which he commands:—"The 13th of November, 1831, at four o'clock in the morning, the sky being perfectly cloudless, and a copious dew falling, we have seen a number of shooting stars, and luminous meteors of great dimensions. During upwards of three hours, more than two per minute were seen. One of these meteors, which appeared in the zenith, left an immense train from

east to west, like a luminous band; and in it many of the colours of the rainbow were distinctly visible: its breadth was equal to one-half of the moon's diameter, and the light which it gave did not disappear for six minutes. We were on the coast of Spain, near Carthagena."

On the 13th of November, 1835, a large and brilliant meteor fell near Belley, in the department of the Ain, and set fire to a farm-yard. In the same night of the 13th of November, a shooting star, larger and more brilliant than Jupiter, was observed at Lille by M. Delezenne. It left on its passage a shower of sparks precisely similar to those which follow a sky-rocket.

The facts we have now given, confirm more and more the existence of a zone composed of myriads of small bodies, whose orbits come within the limits of the earth's ecliptic every year between the 11th and 13th of November. This is a new planetary world which begins to open to us. It is almost unnecessary to state how highly important it is to ascertain if other masses of asteroides do not come within the earth's ecliptic at other points than that which it reaches about the 12th of November. It is desirable to make observations between the 20th and 24th of April, as well as in November; for in 1803, on the 22nd of April, I believe, from one o'clock in the morning until three, shooting stars were seen in all directions in such great numbers in Virginia and Massachusetts as to be compared to a shower of sky-rockets. Messier states that on the 17th of June, 1777, towards noon, he saw, in the space of five minutes, a very large number of black globules pass over the sun's disc. Were not these globules, also, asteroides?

Nautical Magazine.

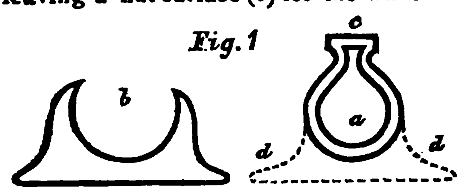
Progress of Civil Engineering.

Ruthven's Improvement on Iron Rails for Railways.

Mr. Ruthven of Edinburgh has bestowed much time and labour in contriving a form of a rail which, he thinks, will be found to possess material advantage over the wrought iron rails now in use. The subjoined figures represent a section of the rail *(fig. 1, a)* and the chair *(b.)*

The rail (*a*) consists of a tube of cast iron, about four or five inches in diameter, and thicker below than above. At top it extends upwards, leaving a flat surface (*c*) for the wheel of the carriage. It is formed in lengths of nine feet, or more, and has a chair, marked by the dotted line *d d*, cast on it at the middle, and, of course, immovable. The chair for joining the ends of two rails is of the form *b*. Its curved interior exceeds a semicircle; so that it embraces and retains the rails without any pins.

Fig. 1



The advantages of this invention in Mr. Ruthven's opinion, are the following:—

1. The hollow rail (the bottom of which, it must be remembered, is one half thicker than the sides and top) is much stronger than a solid rail of the same weight and materials. 2. The tubular form is a secu-

rity against its bending laterally outwards or inwards. 3. The joined ends, being embraced within the chair, are more effectually secured from springing up than in the usual way, by pins; while the rail is prevented from rolling in its seat by the fixed chair *d d*. 4. The longitudinal contraction or expansion of the rails, by variations of temperature, is provided for by the absence of the pins, without producing any looseness. 5. He thinks cast-iron might be employed in this way for rails, instead of malleable, with a great saving of expense; and it is allowed, we believe, that, except for its frangibility, cast iron is the preferable material. The form, however, is quite consistent with the use of wrought iron. He has had some lengths of rails cast, and he has found by experiment that a yard of it, weighing 48 lbs., placed with its two ends on rests, supports a weight of more than ten tons.

We think there is merit enough in these rails to deserve a trial, which could be easily made by laying a space of twenty yards with them, in some of the existing railways where locomotive engines are used.

We mentioned some time ago, that Mr. Ruthven was erecting one of Avery's engines (an American invention,) which works by the reaction of steam, without beam, crank, piston, or valve. It is now ready, and will be at work in his own premises as soon as the masonry and external parts are completed.—(*Scotsman*, Aug. 26, 1837.)

The following account of Mr. Ruthven's rails has been addressed by himself to the editor of the *Scotsman;* that intelligent and scientific gentleman having, with his usual attention to every description of improvement, given the notice of it which we have just quoted.

'Having for many years devoted much attention to this important subject, it may be considered as the result of well-matured investigation; and, although it may surprise many that there should be any difficulty in deciding on the best *form* of rail that can be adopted, after the experience had in the various railways established both in Europe and America, yet it appears that much misconception in regard to the proper *form* is still entertained. For instance, the rails on the Liverpool and Manchester Railway, without being greatly varied in form, have been changed in weight from 35 lb. to 75lb. a yard. The expense attending such a change need not be stated: this and many others are proof how far the strength and weight of rail have been considered more important than the form.

"It has been supposed that a proper knowledge of the strength of iron was generally possessed, and that nothing more was required but to increase the weight of rails, and the desired object would be attained. It may be demonstrated, however, that *form* is equally important as weight. All admit that a tube is much stronger than the same quantity of material in a solid body. It may also be supposed to be admitted that the rails give resistance to the carriages, or weight, on them, by the tension of the metal on the under side, and compression on the upper. Many interesting experiments have been made to ascertain the relative strength of rails, and compare one kind of iron with another; but this has been done more to ascertain the proportional strength in the difference in the weight of material, than in the variety of form; for a given weight of material appears hitherto to have been more considered than the form.

"I shall now, therefore, call your attention, and that of those connected with this national improvement, to the interesting fact, published in your paper of the 16th inst., as having been stated at the recent meeting of the British Association in Liverpool, by Messrs. Fairbairn and Hodgkinson; viz., 'The next experiment was on castings of a T form, or resembling railway rails, which were broken with the flange both upwards and downwards. In the first experiment, with the flange downwards ⊥, the bar of cold blast iron bore a weight of 1050lb. They then reversed the bar's position, putting the rib downwards T; and the bar broke with a weight of only 266lb.; so that there was a great difference, and this was of great importance in reference to the *shape* of *rails*, beams, &c., for bearing heavy weights.' This is certainly too important to be passed over without particular notice, and is the point to which I wish to call attention. The rail proposed by me is tubular; and, being laid horizontally, increased strength is gained by increase of thickness on the under side of the tube, producing similar effect to the above ⊥ bar, which in this position made a difference of strength in the ratio of 1050 to 266 over the former T. But the improvement in strength is made greatly more than the ⊥ form, by continuing the flange, until it meet the bar at the upper side on which the wheels run, as shown in fig. 2.; for a rail weighing 48lb., in this form, is able to sustain, without fracture, a pressure of upwards of ten tons bearing on the centre of it. By this circular or tubular form, in addition to general strength, the rail is secured against *side deflection*, which takes place in the rail at present in use, destroying the power employed, and the rail itself to a great extent, and is generally the cause of a carriage running off the railway.

2

"This, then, may be considered as two important objects gained; that of strength with less material, and avoiding deflection both vertical and horizontal. The chair at the joinings is the next point to call attention to. The hollow rail being circular the chair is formed to embrace more than half of the tube, as illustrated by the diagram given in your paper of the 26th ult., which most effectually secures the rail from rising, or, indeed, from every motion (except expansion or contraction,) *merely* by the *form*, which supersedes the necessity of locking or keying as hitherto, and avoiding the disagreeable shake in passing over the joinings of the rails; this, therefore, may be stated as a third improvement; as a fourth, the saving of expense, which will be found, *cæteris paribus*, to be greatly less than those at present in use. I have it not in my power to make these rails on a great scale; but I have some yards ready to exhibit to the public, and shall be happy to give every information desired to those who may consider it deserving their attention.—I am, Sir, &c.—*John Ruthven.*" *Scotsman*, September 23, 1837.

Archtec. Mag.

Estimated quantity of coal in the Derbyshire and Yorkshire Coal Fields.

It has often been asked, how long the mineral resources of Great Britain are likely to prove available? and when we consider that not only our public welfare, but political existence, as a nation, is involved in the result, the great importance of this question must be acknowledged.

By geological investigation, we fortunately find that the time is very far distant when any scarcity of coal is likely to exist. It is with a view of ascertaining our mineral wealth, that I take the liberty of requesting the insertion of this paper in your Journal, the object of which is to estimate the quantity of coal contained in a certain extent of country, and, by inviting similar communications, to arrive at an approximate result for the whole kingdom.

The district that I shall select for elucidation, is that part of the Great Eastern and Midland Counties Coal-field, which lies between a line drawn from Nottingham to Derby, on the south; and another parallel line from Huddersfield to the eastward, on the north; this will comprise a district of country fifty miles in length; the breadth will obviously depend upon the depth to which the various seams of coal may be worked. The development of science, and its application to mining will, no doubt, afford a facility for working mines much deeper than we can at present calculate upon: if, therefore, 500 yards is assumed as an average, it cannot be objected to even as a maximum, that depth having been considerably exceeded at the present time.

The inclination, or dip, of the strata is the next consideration, as several considerable counter basins occur along the district; if 5000 yards is taken for the breadth at which coal may be got at each without exceeding the specified depth, it will be under the average. By inserting sections taken in different parts of the field, it would illustrate the subject, by showing the various beds of coal, their thickness, and where they are now worked, but this would make the present paper too long-winded; I have, therefore, taken the average of several sections; and find that the total thickness of good workable coal exceeds forty-six feet. We have, then, 50 miles×5000 yards=90,900 acres, which, at 800 tons per foot in thickness per acre, will give in round numbers 3,490,000,000 tons or 116 years supply for the whole kingdom, at the rate of thirty million tons per annum. The average yield I have taken is less than it ought to be, if the best method of working was adopted, but in some parts of the district, particularly in Yorkshire, there is such a deep-rooted prejudice against the long-work system, that many years will probably elapse before the present slovenly mode of working is abandoned and a more economical one adopted. ALPHA.

Min. Jour.

Coal in France.

Coal mines are worked in thirty-four of the departments of France, but in most of them only to a very small extent. Four-fifths of the entire production are drawn from the four departments of Loire, Nord, Saone-et-Loire and Aveyron. The number of coal mines is stated to be 209, of which only 140 were worked during the year 1834. The quantity of coal extracted was 1,550,530 tons the value of which, at 7s. 6d. per ton, amounted to 581,447*l.* Min. Jour.

Mechanics' Register.

Present state of Athens.

The *Courier Grec* contains the following article:—There are very few

foreigners who have a knowledge of the state of Athens at the present moment. It is commonly judged of from descriptions written before it became the seat of actual government. At that period, Athens presented only an immense mass of ruins, among which there could scarcely be reckoned twenty elegant houses. Two years have elapsed since then, and these ruins have for the most part disappeared; they have been replaced by several paved streets, adorned with fine houses and public buildings. There now exist at Athens a civil and a military hospital. The mint is calculated to attract attention from its fine proportions; adjoining it are several well-built barracks, a printing and a lithographic office, and thirteen small churches. Four large churches and a university are about to be erected. The new palace of the king will bear comparison with the finest Grecian buildings of antiquity. Already there are in Athens twenty public wells, besides which, all the public establishments, as well as many private houses, possess their own wells. The houses pay a small tax for the water. All these wells are supplied from two sources; one of which rises on Pentelicus, and the other at the foot of Hymettus. When the first census was made in 1833, the population was 7000 souls: at present it exceeds 18,000, including the garrison and foreigners. It is rare to meet a beggar in the streets of Athens; and, in fact, their number is small compared with that of the population. For the instruction of youth, the town of Athens possesses great advantages. It is the seat of a Greek university, and of a college, where the government has founded thirty pensions for the benefit of poor students. There is a Greek school, a parish school, and other primary schools for the instruction of children in reading and writing; and we ought not to pass over in silence the girls' school, directed by Madame Volmeranhe, in which fourteen young girls are brought up at the expense of government. (*L' E'cho du Monde Savant*, August 5, 1837.) Arch. Mag.

Vegetable Origin of the Diamond.

At the late meeting of the British Association, Sir Philip Egerton brought forward a paper furnished by Sir David Brewster, establishing indisputably the *Vegetable Origin of the Diamond.* It is now as certain that crystallized carbon is of vegetable origin, as coal itself. Layers of different degrees of hardness, and possessing different powers of refraction have been found in the diamond; and these layers, which are superimposed on each other like the coats of an onion, possess different specific gravities. It was inferred that the diamond, in its pristine state, must have been a soft body, like amber or gum, and that it was probably expanded by the gaseous bodies imprisoned in its cavities. In commenting on this paper, Professor Sedgwick announced a fact new to us, and probably so to most of our readers, namely, that particles of silica had been discovered in the ashes of burned wood. Mag. Pop. Sci.

Lunar Occultations for May 1838.

LUNAR OCCULTATIONS FOR PHILADELPHIA, MAY 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
4	14	48	Im. β Virginis	3, 4	41°	91°
4	15	35	Em.		263	313
10	9	57	N. App. ☽ & α Scorpii ☽ South 3.'2			
15	14	59	Im. 39 ε Capricorni	5	146	111
15	16	2	Em.		260	234
27	8	16	Im. 19 λ Cancri	6	93	150
27	9	11	Em.		219	274

Meteorological Observations for February, 1838.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches	Inches			Inches.	
☾	1	14°	26°	30.20	30.10	W.SW.	Moderate.		Cloudy—do.
	2	21	24	29.90	29.84	NE.W.	do.		Cloudy—lightly cloudy.
	3	15	20	29.70	29.62	NE.	do.		Cloudy—do
	4	12	20	29.66	29.60	W.	Boisterous.		Cloudy.—lightly cloudy.
	5	20	30	29.74	29.74	W.	Moderate.		Partially cloudy—do. do.
	6	20	31	29 90	29.97	W.	Brisk.		Clear—do.
	7	18	38	30.01	29.90	SE.	do	.45	Cloudy—rain.
	8	40	54	29.50	29.50	SW.	Moderate.		C oudy—do.
○	9	35	36	29 50	29.50	W.	do.		Cloudy—do.
	10	24	34	29.70	29.70	W.	Blustering.		Cloudy—do.
	11	26	36	29.54	29.54	S.W.	Brisk.		Cloudy—partially do.
	12	16	32	29.95	29.95	W.	Moderate.		Clear—do.
	13	27	38	29.90	29.80	E.NW.	do.	.46	Cloudy—do.—rain
	14	25	27	29.85	29.90	NNW.	Brisk.		Clear—do.
	15	14	21	29.93	29.85	NE.	Moderate.		Snow—Cloudy.
	16	21	24	29.55	29.25	NE.	do.	.65	Cloudy—Hail.
☽	17	9	17	29.90	29.90	W.	Blustering.		Clear—do.
	18	14	29	29.83	29.75	W.	Moderate.		Clear—do.
	19	21	28	29.70	29.70	W.	Brisk.		Partially cloudy—clear.
	20	16	25	29.75	29.75	W.	do.		Clear—do.
	21	6	20	29.85	29.90	W.	do.		Clear—do.
	22	13	24	30.00	30.00	W.	Moderate.		Clear—do.
⊗	23	16	28	29.95	29.80	W.	do.		Clear—do.
	24	20	21	29.80	29.83	W.	Brisk.		Clear—do.
	25	9	19	30.00	30.00	W.	Moderate.		Clear—do.
	26	10	28	29.93	29.93	W	Brisk.		Clear—do.
	27	14	32	30. 5	29.96	W.	Moderate.		Clear—lightly cloudy.
	28	11	24	30. 5	30. 7	N.W	Brisk.		Clear—do.
	Mean	18.42	28.00	29 84	29. 80			1 56	

		Thermometer.	Barometer.
Maximum	height during the month	54.00 on 8th.	30.20 on 1st
Minimum	do.	6.00 on 21st.	29.25 on 16th.
Mean	do.	23.21	29.82

JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

APRIL, 1838.

Practical and Theoretical Mechanics and Chemistry.

On Hydraulic and Common Mortars. By General Treussart, *Inspecteur du Genie. Translated from the French by J. G. Totten, Lt. Col. of Eng. and Brevet Col. United States Army.*

(Continued from p. 166.)

Article xii.—*Of mortars made of Hydraulic lime and sand, or of Hydraulic lime and Puzzolana.*

After I had become acquainted with the good qualities of the Obernai hydraulic lime, I used it not only for works in water, but also for masonry in the air. It required some patience to change the habits of the workmen, and to bring them to the use of other means than those they had been accustomed to apply to the slaking and management of fat lime; but I was ably seconded by Lieut. Col. Finot of the Engineers, who was charged with the immediate superintendence at Strasburg; and, thanks to his efforts, all the persons employed soon became familiar with the manner of treating hydraulic lime, and excellent results were obtained.

In the observations made by Mr. Vicat on the pamphlet published by me in 1824, he thus expresses himself: "Mr. Treussart pretends that hydraulic limes are only made in order to obtain mortars which will harden in water: so far from that being the case, it may, on the contrary, be said, that hydraulic limes (when the country does not furnish them naturally) are made only because mortars composed of these limes and common sand are, at the same time, the most economical and the best, that have yet been discovered, to brave the inclemences of the weather, resist the alternations of hot and cold, wet and dry, &c."

It is true that at page 46 of my pamphlet I said "The author observes that hydraulic limes are made only to compose mortars which have the property of hardening in water. Since this result is obtained, directly, with fat lime and factitious trass, and the results thus obtained are the best, he thinks this mode the most advantageous." This passage cited independently, might lead to error: but, as in all that preceded, the question was, only, as to works in water, it means that when there are works to be built in water, it is necessary to produce hydraulic mortars; and that when there

is not, on the spot, natural hydraulic lime, it is preferable on all accounts, to make hydraulic mortar of fat lime and factitious trass, instead of making artificial hydraulic lime according to the process of Mr. Vicat. I did not in the pamphlet of 1824, give details as to the manner of employing hydraulic lime in the air, because I had not then facts enough to warrant it; but I did not say that they might not be employed with advantage in constructions in the air: very far from that—for my experience having taught me, on several occasions, how dangerous it is to use in the air hydraulic lime that has been too much burned (and I may add that it is as dangerous in the water) I said, speaking of hydraulic limes, at page 5 of the pamphlet, that, "if they are used in the air when too much burned, they may occasion very serious accidents, because they dilate considerably, and may heave up very large stones; it is therefore important to employ this lime only when it is calcined just enough." We see therefore that I was far from thinking that we should not use hydraulic limes in the air: but that I thought it my duty to notify that they must not be made use of when too much burned, because of the serious accidents that might result. If this observation had been attended to, the works of the *Vésére* would not have sustained the serious accidents that obliged them to rebuild several Locks. At Strasburg, care was taken to reject such pieces as were too much burned; and although it often happened that mortar of the ordinary consistency, made of lime just from the kiln, was used, no serious accident befel.

All the officers of the Corps of Engineers are acquainted with Metz, and know the good quality of its hydraulic lime—there used in air as well as in water. I have, myself, used the lime under several circumstances; and, as I observed in the first section, there was built at Strasburg, under my direction from 1816 to 1825, more than a million of masonry, both in air and water, of hydraulic lime. Mr. Vicat was, therefore, altogether deceived as to the sense of the phrase which he quoted; he, moreover, has himself said nearly the same thing: for, in commencing the second section of his work, he says, page 31, "hydraulic mortars, as the name indicates, are designed for masonry to be placed in water: they are also called betons." Were this phrase cited alone, we might apply to Mr. Vicat the reproach he directs to me. I do not think that Mr. Vicat wished us to understand that this lime should not be used in the air; because every body knows that it may. Not only do I think that hydraulic mortars are the best to be used in constructions in the air; but—much more than that, my labours have led me to think that, with fat limes, moderately good mortars cannot be made, in whatever manner treated, if no hydraulic cement be added to them: which is saying, in a word, that the sole means of obtaining good mortars in the air, is to use only hydraulic mortars. The only essential point in which I differ from Mr. Vicat is, that I think—as in mortars for the water, it is preferable to make the hydraulic mortar, directly, with fat lime and factitious puzzolana or other like substance, instead of making hydraulic lime by the process he has indicated, when in a country where there is none naturally good. This method has, besides, the advantage that in countries where the lime is only moderately hydraulic, the mortar may be sensibly meliorated by adding a small quantity of hydraulic cement and a greater quantity of sand, (which would be but a small expense;) while according to the process of Mr. Vicat, it would cost as much to improve, suitably, the moderately hydraulic lime thus at command, as to produce the entire conversion of fat lime into hydraulic lime.

I shall give, in the following tables, results which I obtained with differ-

ent hydraulic limes from the environs of Strasburg, Metz, and other places.

Table No. XXXV.

No. of the mortars.	Composition of the mortars.			made immediately.	After 15 days	After 1 month.	After 2 months.	After 3 months.	After 4 months.
				lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	Yellow Obernai slaked to powder and measured in powder Sand	1 2	3	99	110	132	99	77	66
2	Same lime Sand Trass	1 1 1	3	231	242	262	246	246	220
3	Same lime air slaked and measured in powder Sand	1 2	3		77	44	55	44	44
4	Same lime Sand Trass	1 1 1	3			231	253	262	253
5	Metz lime slaked to powder and measured in powder Sand	1 2	3	114		88	44		
6	Same lime Sand Trass	1 1 1	3	268		231	220		
7	Same lime air slaked and measured in powder Sand	1 2	3			66	40		
8	Same lime Sand Trass	1 1 1	3			242	253		
9	Another Obernai lime slaked to powder and measured in powder Sand	1 2	3	220	121	88	77	66	
10	Same lime Sand Trass	1 1 1	3	264	264	286	297	275	
11	Same lime air slaked and measured in powder Sand	1 2	3		88		55		
12	Paris hydraulic lime slaked to powder and measured in powder Sand	1 2	3	187		121			
13	Common lime reburnt with 2-10 of Holsheim clay, slaked to powder and measured in powder Sand	1 2	3	176		110	88	55	44

Observations on the experiments of Table No. XXXV.

All the experiments of this table were made with lime that had been slaked to powder with one-fifth of its volume of water: and the proportions were, one part of lime in powder to two parts of sand.

The first four mortars of the series were made of the same Obernai lime as those of table No. VI which were put into water. No. 1 was composed of lime and sand. If we compare its resistance with that of the like mortar of table No. VI, we shall see, 1st. that the piece of lime which, with sand, produced mortars of feeble consistence in the water, has also given

feeble results in the air (it appears that the piece of lime was but slightly hydraulic:) 2d. that the tenacity of the mortars has, alike in both cases, augmented for a certain length of time, after which it rapidly decreased: 3rd. that the mortars left in the air, have generally given a weaker resistance than those placed in water.

Series No. 2 was made of lime, sand and trass, in equal parts. The result we see is much meliorated. The resistance went on increasing like the similar mortar of table No. VI. These mortars, also, exhibited less tenacity than those under water.

Series No. 3 was made of the same lime left to slake spontaneously. The proportion was one of lime, in powder, to two of sand. It was not till after fifteen days that I could procure enough lime in powder to commence the experiment. If the results be compared with No. 1, we shall see that lime air-slaked gave resistances much inferior to those obtained with lime slaked by water to powder—as was the case with mortars put under water.

Series No. 4 was made of air-slaked lime, sand and trass, in equal parts. These results being compared with those of the 2nd. series, we see but slight difference: if compared with the like mortars put under water of table No. VI, we see that they are sensibly inferior.

The series No. 5, 6, 7 and 8 shows similar experiments with Metz lime; these mortars are made of the same lime as those of table No. VII, which were deposited in water. The results given by the Metz lime are weak; but it is probable that with this lime, as with others of the like nature, very different results are afforded by different pieces from the same quarry. I am not entitled to say that the Metz lime is inferior to the Obernai lime, not having made experiments enough with the former to be able to compare. The observations made on the first four series of table No. XXXV, apply, generally, to the mortars made of Metz lime.

Series Nos. 9, 10 and 11 were made of the same Obernai lime, as the mortars of table No V which were put under water: the results are good. No. 9 shows that if not made up till it has been slaked fifteen days, this lime loses nearly one half of its force: and that it loses more and more as this period is extended. If we compare the mortar made immediately, with its analogous experiment in table No. V, we shall see that the mortar left in the air supported 44 lbs. less than the mortar left in water. With the other mortars the differences are not so great.

In comparing series No. 10 above, with the corresponding series in table No. V, we find that the mortar made immediately, gave a resistance only about one-half of that of the similar mortar of Table No V; while the mortar No. 2 of the present table, made of another lime, supported a weight rather greater than the similar mortar of table No. VI, which had been put in water. I cannot explain this anomaly. The other mortars of this series, made at different periods, were inferior, or at most only equal to the corresponding mortars that had been put in water.

The series No. 11 comprises only two experiments with lime left to slake spontaneously: these two experiments consumed all the lime. The results are weaker than the corresponding ones of series No. 9 of which the lime had been slaked to powder with water, agreeing in this respect with the comparison of No. 1 and 3 above.

Series No. 12 comprises two experiments only, made of artificial hydraulic lime manufactured at Meudon, by Mr. Saint Leger. Having but a small quantity of lime, I was unable to make a greater number of experi-

ments. The resistance of mortar made immediately, is good: that made at the end of a month has lost nearly half its force. Two mortars made of the same lime and put into water, are given at No. 1 of table No. X. On comparing them we see that the mortar made at once and left in the air, supported the same weight as that put in water. Mortar made of this lime after being slaked a month, gave when exposed to the air, a resistance of 121 lbs. and when plunged into water, only 88 lbs.

Series No. 13 is of mortar made of an artificial hydraulic lime composed of fat lime and Holsheim clay. The result is nearly the same as that of series No. 12. We see that the strength of the mortar diminished rapidly by the exposure of this lime to the air; and that at the end of four months it had lost three-quarters of its strength.

I made but few experiments with artificial hydraulic limes in the air, but those which I did make, show that they differ in nothing from natural hydraulic limes. They show, also, that in the air, as well as in water, better mortars are generally obtained with fat lime, sand, and substances analogous to puzzolana, than with hydraulic lime and sand.

On comparing the above mortars, left in the air, with the same mortars put in water, we are led to the following conclusions: when mortars are made of hydraulic lime and sand, to be used in masonry exposed to the air, it is of great importance to use the lime soon after it is burned: otherwise it loses a great portion of its force, as it does under water. When we are obliged to wait some days before using it, it should be slaked to dry powder, by throwing on a quarter of its volume of water, and be immediately covered with the quantity of sand that is proper to mix with it to make mortar. These kinds of lime should not be left to slake spontaneously, because they require a considerable time to become reduced to powder, and in general, lose a great part of their energy. Before deciding on adopting the process of air-slaking for hydraulic limes, we should previously convince ourselves by experiment, that the particular limes are exceptions to the general rule; that is to say, that they do not lose a great part of their energy by being left to slake in this manner. If the hydraulic lime we have at command has no great force, we may, nevertheless, make very good mortar by mixing sand, and a quantity of some substance analogous to puzzolana with the lime. For example, with calcined clay-dust of good quality, we may have a mortar of great hardness (even when the lime has very little hydraulic property, or is nothing but fat lime) by mixing lime, sand, and clay-dust, in equal parts: but a less proportion of clay-dust may suffice, with a greater degree of hydraulic strength in the lime, or if the work consist of gross masonry.

Comparing mortars made of the same constituents, and in the same manner —some having been left in the air, and others put under water, we see that the latter, in general, have given the greater resistances. Humidity is, therefore, favourable to hydraulic mortars. In the case of masonry made of fat lime, it has always been recommended, if earth was to be laid against it, that it should be left to dry for some time, before backing it with earth; and with the same object it has been directed to wait a year before pointing the work. We see that with hydraulic mortars used in the air, it will be better to act differently. As the masonry rises, it will be best to throw the earth against it. The pointing should be finished at the same time as the masonry, this being the better and more economical mode. During warm weather, the top of the wall should be copiously watered, at the

close of the day, and whenever the masons break off during the day. This was always done at Strasburg, and was found to be a good practice.

I shall give in the following table several experiments that I made with various kinds of lime, in order to know their quality and the quantity of sand that might be mixed with them.

Table No. XXXVI.

No. of the Mortars.	Composition of the mortars.			Weights supported before breaking.
				lbs.
1	Yellow Obernai lime slaked to powder and measured in powder	1	3	196
	Sand	2		
2	Same lime	1	3½	161
	Sand	2½		
3	Same lime	1	4	99
	Sand	3		
4	Yellow Obernai lime measured in paste	1	3	301
	Sand	2		
5	Same lime	1	3½	275
	Sand	2½		
6	Same lime	1	4	242
	Sand	3		
7	Another Obernai lime measured in paste	1	3	220
	Sand	2		
8	Same lime	1	3¼	165
	Sand	2¼		
9	Same lime	1	3½	143
	Sand	2½		
10	Same lime	1	3¾	88
	Sand	2¾		
11	Same lime	1	4	66
	Sand	3		
12	Yellow lime of Bouxviller measured in paste	1	3	231
	Sand	2		
13	Same lime	1	3¼	242
	Sand	2¼		
14	Same lime	1	3½	253
	Sand	2½		
15	Same lime	1	3¾	231
	Sand	2¾		
16	Same lime	1	4	187
	Sand	3		
17	Oberbronn lime measured in paste	1	3	297
	Sand	2		
18	Same lime	1	3½	165
	Sand	2½		
19	Yellow Obernai lime alone—reduced to paste			323

Observations on the Experiments of Table No. XXXVI.

The first three numbers were made of the yellow Obernai lime, slaked to powder soon after leaving the kiln. The proportions were one part of lime to the several quantities of sand stated in the table. We see that the strongest result corresponds with the least quantity of sand. Different circumstances having taught me that hydraulic lime would not bear as much sand as is commonly thought, I proportioned the following mortars with lime measured in paste.

Nos. 4, 5 and 6, were made at the works, and consequently with mixed

pieces of lime; the proportions are shown in the table. The best result answers to one of lime and two of sand, and it will be remarked that these three mortars are superior to the first three, which I attribute principally to a smaller quantity of sand.

The numbers from 7 to 11, were made of lime from another burning: the sand was augmented each succeeding trial by a quarter of the bulk of lime, while in the preceding experiments it had been augmented by a half. The best result corresponds with one part of lime in paste to two parts of sand; it is possible that a smaller proportion of sand would be still better, for we see that No. 19, which is lime reduced to paste without any sand, gave a stronger result; but as No. 19 was made of lime of another burning, I placed it at the end of the table that it might not lead to any false conclusions. I did not anticipate that there may be good hydraulic limes which will support only a very small quantity of sand; otherwise, I should have commenced the series with a much smaller proportion.

The numbers from 12 to 16, are mortars made of the hydraulic lime of Bouxviller, a small village situated at the foot of the Vosges, between Haguenau and Savern. This lime was treated in the same way as the Obernai lime that precedes it in the table. We see that the Bouxviller lime will bear more sand than that from Obernai, and that the best result corresponds to the proportion of one part lime measured in paste to two and a half parts of sand. The lime was of the same burning as that used in table No. III. Comparing the figures of the two tables, I was surprised to see that the same lime supported more sand in the air than in the water, which has happened very rarely in the course of my experiments; I am ignorant whether this is owing to some peculiar circumstance, or is a quality pertaining to certain hydraulic limes.

The experiments Nos. 17 and 18, were made with lime from Oberbronn, a village at the foot of the Vosges, to the left of the road from Haguenau to Bitche. I obtained a very good result with one part of this lime measured in paste and two parts of sand; but No. 18 shows that by putting two and a half parts of sand in the mortar, it lost nearly half its force. When making these two experiments with Oberbronn lime, I put, on one side, a fragment which I slaked with one-fifth of its volume of water, so as to reduce it to dry powder. I left it in this state, in the air, for fifteen days. I then made a mortar like No. 17. This mortar broke with the weight of 132 lbs., in lieu of the 297 lbs. which the mortar supported when made of lime just slaked. I obtained a similar result with the Bouxviller lime. All the limes, therefore, which I have used in my experiments in the air, and which are included in the preceding tables, require to be used a very short time after being burned: they lose, otherwise, a great portion of their energy; as is also the case when they are used in water.

No. 19 was made, as I have said, of Obernai lime, alone, reduced to paste with water. When I saw the hardness of this hydrate, my intention was to make similar trials with other limes, in order to know if the sand added in the composition of mortars, always, or only with some peculiar limes, diminished the resistance of the hydrates: but I was obliged to quit Strasburg before it was in my power to make the essays.

Article xiii.—*Various experiments with Mortars exposed to the Air.*

In this article I shall give several experiments which I made on mortars

exposed to the air. Several are repetitions of those contained in article VII, of mortars placed in water.

Table No. XXXVII.

Composition of the mortar.	Made immediately.	After 12 hours.	After 24 hours.	After 36 hours.	After 48 hours.	After 60 hours.	After 72 hours.	After 84 hours.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Obernai lime slaked to a moist powder, with a volume of water equal to the volume of lime . . . . . 1; Sand . . . . . . 2 } 3	220	209	165*	132	132	110	92	68

Observations on the experiments of Table No. XXXVII.

The above experiments were made with the same lime, and in the same proportions, as those of table No. XXVI, of which the mortars were put in water. For the manner of operating, I refer, therefore, to the observations on table No. XXVI.

These air mortars behaved like those placed in water. The mortar made immediately, afforded, in the air, a resistance rather less than the corresponding mortar of table No. XXVI; the others gave results about the same in the two cases. It is therefore important not to slake hydraulic lime with too much water, whether it is to be used in the air or in water; and we perceive that the method proposed by Mr. Lafaye is very inconvenient for hydraulic lime, because it requires the quick lime to be broken into small pieces of nearly equal size, which is a long and expensive operation. Unless this be done, the small pieces will absorb too much water, and the large pieces too little.

Table No. XXXVIII.

No. of the mortars.	Composition of the mortars.	Weights supported before breaking.
		lbs.
1	Mortar made of equal parts of common lime, sand and trass	143
2	Same mortar, worked anew, without water, after 12 hours	154
3	Same mortar, worked anew with a little additional water, after 12 hours	209
4	Same mortar, do. after 24 hours	198
5	Same mortar, do. after 36 hours	165
6	Same mortar, do. after 48 hours	187
7	Mortar of 1 part of Obernai lime and 2 parts of sand .	154
8	Same mortar, worked anew with a little additional water, after 12 hours	176

Observations on the experiments of Table No. XXXVIII.

These experiments were made with the same lime as, and in a simila manner to, those recorded in table No. XXVIII. The first six mortar correspond to Nos. 1, 3, 4, 6, 8, and 10, of that table, which were pu under water. I made similar trials with lime and sand only; but, as I use lime which had been slaked for some time, I obtained only feeble results— the greater part of the mortars not supporting the weight of the scale pan.

If we compare No. 2 of the above table with No. 1, we see that the mo

*This mortar was cracked, which may have lessened its resistance.—Author.

tar that was reworked without water, after twelve hours, gained but little upon that which had not been reworked; but that No. 3, which had been reworked with a little water, had gained a good deal. After twenty-four hours, the mortar No. 4 had become so dry that it was impossible to rework it without water; I was therefore obliged to moisten it a little, like No. 3. We see that the result was about the same as at the end of twelve hours. After thirty-six hours the hardness had become sensibly weaker, and at the end of forty-eight hours it had become stronger than at the end of thirty-six hours—an anomaly which I cannot explain.

Comparing the results of the above table with the corresponding ones of table No. XXVIII, we find that the resistances of the mortars left in the air are sensibly less than those placed in water. We see also that in both cases, I obtained no advantage of consequence, by reworking the mortars without additional water; but that there was a material augmentation of force, on reworking the mortars with a little water.

Nos. 7 and 8, of the above table, answer to Nos. 13 and 14 of table No. XXVIII, and were made of the same lime. There is in these mortars, also, much resemblance as to the effect of reworking upon mortars in air and in water; that is to say, the mortar which had been reworked with a little water after twelve hours, presented a greater resistance than that which had not. The resistances of these tables are generally rather weak, because of my using lime which had been slaked for about fifteen days.

At all works, it is often necessary to rework the mortars in the course of the day, especially in hot weather, when it dries very quickly and becomes too stiff to be used. During the hours of recess from labour, and when the works are interrupted by rain, the mortar will harden considerably. It would sometimes demand a great deal of labour to restore the mortar to a suitable consistency without water. My practice has always been to add a little water whenever the mortar had become, from any cause, too stiff, and required reworking. The preceding remarks show that no disadvantage attends this mode of operating. There is, no doubt, a limit, both as to the quantity of water to be added, and as to the time elapsed before reworking; and I purposed making other experiments in order to ascertain these limits, but I had not time. The experiments cited are nearly sufficient, and they prove that the opinion on which is founded the saying that "*mortar should be tempered with the sweat of the workmen,*" is a prejudice leading to considerable useless expense. The essential point is, that the lime, and the substances added to it, be intimately mixed; and this is most easily accomplished when the mortar is soft.

Table No. XXXIX.

No. of the mortars.	Composition of the mortars.			Weights supported before breaking.
				lbs.
1	Obernai lime slaked to powder, with 1-5 of its volume of water, leaving it in the air	1	3	154
	Sand	2		
2	Same lime, slaked to powder with 1-5 of its volume of water, covering it with sand	1	3	154
	Sand	2		
3	Same lime, slaked by plunging it into water for fifty seconds	1	3	132
	Sand	2		

Observations on the experiments of Table No. XXXIX.

These experiments are the repetition of those described in table No. XXV, and they were made of the same lime. The results are similar to those given by mortars put under water; only they are a little weaker. The comparison of Nos. 1 and 2 shows that there is no advantage, when slaking lime, to cover it with sand. This is called *stifling* the lime; and several constructors think that the vapour which rises, on slaking, posses-ses valuable properties.

Mortar No. 3 of table No. XXXIX was made of the same lime as No. 3 of table No. XXV, and I used, in slaking the lime, the process recommended by Mr. Lafaye, which consists in dipping the quick lime into water. The resistance was less than No. 1, which was slaked by throwing on a little water. This appears to me to be owing to the pieces of lime absorbing too much water from being in small pieces; and as the lime remained twelve hours in this state, it lost a part of its force—for it follows, from tables Nos. XXVI and XXVII, that lime, slaked to a humid powder has already lost a part of its energy, when it has lain twelve hours exposed to the air.

Table No. XL.

No. of the mortars	Composition of the mortar.			Weight suppor-ted before break-ing.
				lbs.
1	Common lime measured in paste Pulverized bricks lightly burned	1 2½	3½	297
2	Same lime Pulverized bricks well burned	1 2½	3½	143
3	Same lime Pulverized tiles lightly burned	1 2½	3½	253
4	Same lime Pulverized tiles wellburned	1 2½	3½	99
5	Same lime Pulverized tiles lightly burned—recal-cined for six hours.	1 2½	3½	0

Observations on the experiments of Table No. XL.

The above experiments are of the same kind as those made with mortars put under water, and reported in table No. XVI. These air-mortars gave similar results with those put in water; that is to say, those made of pulverized bricks, or tiles, but lightly calcined, gave much better resistances than those made of more highly burned bricks or tiles. We see that the dust of No. 5, which had been recalcined by being kept red hot for six hours, gave with the same lime, a mortar that had no strength. The dusts used in these trials, like those of table No. XVI, contained a notable quantity of lime. The resistances of the mortars left in the air, were, in this instance also, rather less than those of the mortars put in water.

Table No. XLI.

No. of the mortar.	Composition of the mortar.			Weight supported before breaking.
				lbs.
1	Common lime measured in paste	1	$3\frac{1}{2}$	132
	Brick dust	$2\frac{1}{2}$		
2	Same lime	1	$3\frac{1}{2}$	165
	Brick dust, same as No. 1, recalcined for half an hour	$2\frac{1}{2}$		
3	Same lime	1	$3\frac{1}{2}$	275
	Brick dust same as No. 1, recalcined for one hour	$2\frac{1}{2}$		
4	Same lime	1	$3\frac{1}{2}$	308
	Brick dust, same as No. 1, recalcined for two hours	$2\frac{1}{2}$		

Observations on the experiments of Table No. XLI.

These experiments correspond with those of table No. XVII, that is to say, having used brick dusts which gave resistances the feebler the more they were burned, as those of tables Nos. XVI and XL—other brick-dusts were found, as those of tables Nos. XVII and XLI, which gave results exactly opposite. The mortars of the two tables XVII and XLI, gave in air and in water, results so much the stronger as the cements had been the more burned. In speaking of tables Nos. XVI and XVII, I said, that the differences were owing to the cements of table No. XVI, containing much lime, while those of table No. XVII, contained little. But the cements of tables Nos. XL and XLI, were the same as those of tables Nos. XVI and XVII, and the results in the air were just like those in the water. The comparison of these four tables leads to an important conclusion; namely, that clay-dusts which give results with fat lime, when placed under water, will also give good results, when exposed to the air: and if the results be bad in the first case, they will be equally so in the second. Whence it follows that to know whether clay dust which is to be used in air mortar, will give good results it should be tried with fat lime in water; following the process pointed out in the first section. We may be certain that cements which have not the property of causing fat lime to harden in water, will give, in the air, no better results than the same lime mixed up with sand alone. On the other hand, the more hydraulic the cements are, the better, for all uses in the air. The trials of which we have spoken, should not be neglected, for they are of great importance, as regards the solidity of masonry exposed to the air.

Table No. XLII.

No. of the series.	Composition of the mortars.	Weight supported before breaking.
		lbs.
1	Obernai lime alone, reduced to paste . .	323
2	Verdt lime alone, reduced to paste . . .	99
3	Metz lime alone reduced to paste . . .	119
4	Lime from the Boulogne pebbles . . .	99
5	Mortar composed of one part of fat lime that had been long lying slaked and wet, measured in paste—and two parts of puzzolana . . .	429
6	Mortar made of one part of same lime do. and two parts of trass . .	451
7	Mortar do. do. do. and two parts of Sufflenheim cement . . .	429
8	Mortar do. do. do. one of sand and one of Sufflenheim cement . .	363
9	Mortar do. do. do. and two pars of forge scoriœ	55
10	Mortar do. do. do. one of sand and one of Paris cement . . .	0
11	Mortar made of one part of fresh lime measured in paste and two parts of common sand .	77
12	Mortar do. do. do. and two parts of common sand pulverized . .	121
13	Mortar made of one part of Obernai lime measured in paste and two and a half parts of common sand	187
14	Mortar of one part of same lime do. and two and a half of sand, pulverized . .	275*
15	Mortar of one part of quick-lime but little burned, measured in paste, and two parts of sand .	—22
16	Mortar made of one part of Lixen lime measured in paste and two parts of earthy sand .	—22
17	Mortar of one part of same lime do. and two parts of River sand - . .	143
18	Mortar of one part of do. do. and two parts of earthy sand, washed . . .	176
19	Mortar of one part of Dosenheim lime and two parts of earthy sand . . .	—22
20	Mortar of one part of same lime and two parts of river sand	132
21	Mortar of one part of do. and two parts of earthy sand washed . . .	176

Observations on the experiments of Table No. XLII.

This table contains a variety of experiments, which I will explain. Nos. 1, 2, 3 and 4 were made of lime slaked soon after being burned, and by the necessary quantity of water, reduced at once to paste. These hydrates of lime like the mortars which precede them, were placed in a cellar, and tested at the end of a year. The hydrate of Obernai lime, No. 1, was very good. No. 2, a hydrate of Verdt lime, gave so feeble a result as to surprise me, after that which I had obtained by placing a hydrate of the same lime in water—table No. III shows that the resistance of this hydrate was 484 lbs. As the specimens were from different burnings, I presume that in this last trial, I used a piece but feebly hydraulic. The Metz lime

*This mortar being a little cracked, its resistance was diminished.

No. 3, gave a feeble result, also. I have already said that I made but few experiments with this lime, and it is possible that the small quantity that was sent me was, by accident, but feebly hydraulic. No. 4 was from the Boulogne pebbles, and was treated the same way as the preceding. The resistance was feeble, and, we have seen (table No. VIII) that, with a single exception of a trial made with this lime highly calcined, all the mortars it has furnished, have supported but small weights. The above lime, No. 4, had received only the ordinary calcination.

Nos. 5, 6, 7, 8, 9 and 10 were made of fat lime that had been lying slaked, and wet, for five years, since the erection of the Theatre. The proportions were one part of this lime in paste, to two parts of the several substances mentioned in the table. The mortar No. 5, composed of this lime and puzzolana, gave a very good result. No. 6 made, in the same manner, of trass, gave a resistance a little better still. Mortar No. 7 made of the hydraulic cement of Sufflenheim, gave a resistance equal to that afforded by puzzolana. Mortar No. 8 made of equal parts of lime, sand and Sufflenheim cement, supported a weight rather less than No. 7, in which there was no sand. No. 9 was made in the same manner as the preceding mortars, using the scoria of forges. I satisfied myself that these scoria contained little or no clay; and it is to this that I attribute the bad result. I said in the first section, that with the Tournay ashes, and the ashes of the forges of Boulogne, very good mortars were made; owing to this, that the sea-coal, burned in the forges of those places, contained a considerable quantity of clay, which was calcined in a current of air, by the combustion of the carbon of the coal. The scoria of forges, and the ashes of furnaces, should not, therefore, be used in mortars in the air, before ascertaining whether these matters have the property of causing lime to indurate under water.

No. 10 is a mortar composed of one part of fat lime measured in paste, one part of sand, and one of Paris cement. This cement was from the manufactory of Mr. Saint Leger, and was the same as that used for the mortars put into water. We saw, at page 22, that two mortars made of this cement had promptly hardened in water, but that both were cracked. The mortar made of one part lime and two parts of cement supported 187 lbs., and that made of lime, sand and cement, supported only 99 lbs. I was much surprised at the bad result of the mortar No. 10 in table No. XLII; it had so little consistence that it crumbled easily between the fingers. I attribute the bad effect to the great quantity of lime that Mr. Saint Leger mixed with the clay, in making the cement. It might be that the cement was too much burned. Some separate trials lead me to think that cements made of clays containing about one tenth of lime, are less proper for mortars in the air than for mortars in water: it appears also that they allow but little sand in the composition of the mortar. I intended making some experiments to settle this matter but had not time. My departure from Strasburg also prevented my making, with the several clays of the environs of that place, experiments in the air, analogous to those which I made with the clays, under water. My various essays, however, induced me to think that in making artificial puzzolanas for mortars intended to be exposed to the air, the presence of lime in the clays to be calcined, is still more hurtful than when the mortars are to be used under water. Clay, therefore, should be chosen which contains no lime or very little.

Nos. 11 and 12 were made of fat lime reduced to paste shortly after burning. No. 11 was made of one part of this lime measured in paste, and two parts of common sand. No. 12 differs only in having the sand pulverized. We see that the result was much better with the fine sand. Nos. 13 and 14 were similar experiments made of Obernai lime. With the fine sand, the resistance was, in this case also, much the greatest, although the mortar was so cracked as necessarily to diminish its force. We have seen in table No. XXIX, that mortars in water gave similar results. We ought to conclude, therefore, that whether for mortars in air or in water, fine sand is the best, notwithstanding the opinion to the contrary of most constructors.

Old mortars are often found which are very hard, and which contain a great quantity of gravel as large as a pea. This fact is sometimes cited to prove that it is best to use coarse sand in gross masonry, but the reasoning is not just. These kinds of mortars are really concretes: the gravel they contain can have no influence on the goodness of the mortar. But if this gravel is mixed with fine sand (as is often the case) and the lime is hydraulic, then a very good mortar is obtained—the strength of the mortar depending on the strength of the lime.

No. 15 was made of lime which had been placed above the tiles in the kiln, and was, therefore, but slightly burnt: it was the same lime as was used in making the mortar to be put in water, No. 8 of table No. XXIX. Only bad mortars were obtained by this means, either in the air or in water.

Nos. 16, 17 and 18 were made of three different kinds of sand and a lime moderately hydraulic, obtained from the village of Lixen, near Phalsburg. No. 16 was made of one part of this lime, measured in paste, and two parts of a very earthy pit sand, which is found in the neighbourhood. The resulting mortar had so little consistency, that it could not bear the weight of the scale pan. No. 17 was mixed in the same proportions with river sand from Zorn, near Saverne; the resistance was passable. The same proportions were observed, in mixing No. 18, with the same sand as was used in No. 16, after being freed, by washing, from earthy matter. We see that this mortar was good, and superior to the mortar made of river sand.

Nos. 19, 20 and 21 were repetitions of three preceding experiments: using, however, another lime, also moderately hydraulic, obtained from the village of Dosenheim. The mortars made of Dosenheim lime, like those made of Lixen lime, prove that earthy sands afford only very bad mortars; but that, being washed, they are superior to river sands. I was led, in 1823, to make these experiments, because there was to be had near Phalsburg only pit sand which was half earth. Whenever there was any work to be executed requiring some care, the people of that place were obliged to get river sand from the river Zorn on the other sides of the Vosges. This brought the price to about \$0.03½ per cubic foot—so high as to prevent its being procured for the masonry of revetments: it resulted that the masonry of that place, made of mortar in which the earthy sand of the neighbourhood was used, has needed considerable repairs, and in making the necessary reconstructions, it was very apparent that the degradations had been owing to the bad quality of the mortar.

After getting the results of these last experiments, I used no sand at Phalsburg except washed pit sand. It required 70.68 cubic feet of the earthy sand to yield 35.34 cubic feet of the washed sand: 0.62 of a day's

work sufficed for the washing: it would, therefore cost less than one half of the expense of bringing the river sand.

The sand may be washed on a large scale in the following manner; a basin being made of masonry from seven to ten feet wide, and from twelve to sixteen long, the height of the walls should be about two and a half feet, with the exception of one end, which should be only one foot two inches high; the bottom should be paved with flat stones; the basin should be built near a stream of water, or if that be not practicable, a well should be sunk near it. A layer of sand of about one foot thick, should be placed in the basin, and a plank one foot four inches wide placed on edge, on the low wall, raising it to the height of the other walls—the plank being fitted into grooves made in the side walls to receive it. The basin must then be filled with water from a brook, or from a pump in a well, as the case may be; and the sand must be well stirred up with *rabs* by two or three labourers. Allowing the time found to be necessary for the sand to precipitate, the plank must be suddenly withdrawn, and a great part of the water will pass off at once, loaded with earthy matter. This operation must be repeated until the water passes off but slightly turbid: the sand may then be taken out and left to dry, and the washing be applied to another portion.

For economy, the basin may be constructed of planks, as was done at Phalsburg. It was six feet eight inches long, four feet four inches broad, and two feet two inches deep. There was left in front an opening of only fourteen inches deep by ten inches broad. But this opening was too small for the water to run off rapidly. It is best to place a movable plank of some breadth across the whole front of the basin, so that the water may pass off very quickly.

The last experiments of table No. XLII, show how important it is to use clean sands in making mortars: but before washing off the earthy matter, it is proper to be satisfied, by the means I have pointed out, that the sands are not arenes.

Article xiv.—*Observations on Mortars exposed to the Air.*

It results from the experiments given in articles XI, XII, and XIII, that in exposing to the air mortars made of sand, and lime which had been laying a long time slaked and wet, I obtained no satisfactory result; while I obtained tolerable results with sand, and the same lime recently slaked. The resistances of these last mortars were 68, 77, and 99 lbs., while the others were unable to support the scale pan, whatever may have been the process of fabrication. I ought not, however, from this to take up a general conclusion, and counsel against slaking and running lime into vats to preserve it; because I have not made experiments enough to pronounce positively on the subject—which is one of great importance. It is necessary to repeat these trials in different countries, so as to operate on various kinds of lime, before proscribing this method; which, while it may be a bad method for certain kinds of lime, may be very good for other kinds. I do not know for how long a time the method of running lime into vats has been followed. It may have been introduced in consequence of the considerable increase of bulk which it gives. I do not know that it was followed by the ancients. Vitruvius has left a work on architecture, in which he has given many details as to the manner the Romans carried on their works. We find in this author, as rendered from the Latin by Perrault, the architect, the follow-

ing passage extracted from Book II, chapter V: "When the lime has been slaked, it must be mixed with sand, in such proportions that there shall be three parts of pit sand, or two parts of river sand to one of lime: because this is the most just proportion of the mixture, which will be much better still, if there be added to the sea or river sand a third part of sifted tile dust."

We see nothing in this passage that indicates the mode of slaking; but it is certain that the Romans made great use of hydraulic lime, as there are many remains of their works in countries where this lime abounds: such are the constructions they have left us on the banks of the Moselle, and in several parts of France. But these limes could not be slaked and left in the above manner, (as they would harden in the water;) and, if it had been the practice to slake them differently from fat lime, Vitruvius would no doubt have mentioned it. It appears probable to me, therefore, that the Romans used fat lime as they did hydraulic lime, that is to say, immediately after the burning. This is the more likely, as Vitruvius directs, in the process of stucco making, that only lime that had been long slaked should be used. The following are his remarks on this subject. Book VII, chapter II. "Having examined all that appertains to pavements, the manner of making stucco must be explained. The principal matter in this is, that the lime should be slaked for a long time, so that if there should be some particles less burned than the rest, they may, having time thus given them, be as thoroughly slaked, and as easily tempered, as that which was thoroughly calcined: for, in lime which is used as it comes from the kiln, and before it is sufficiently slaked, there is a quantity of minute stones imperfectly burned, which act on the plaster like blisters, because these particles slaking more slowly than the rest of the lime, break the plaster and mar all the polish." It appears to me that the precaution of slaking the lime a long time before hand, is here recommended as an exception, and that in the mortars intended for masonry, the Romans used all limes soon after they left the kiln. It is remarkable that the same author directs, in the first passage cited, mixing with the mortar a portion of sifted tile dust, observing that it will much improve the mortar.

We have seen that my experiments were very unfavorable to the process indicated by Mr. Loriot and Mr. Lafaye: they were in error in recommending them as, in principle, recovered from the Romans. Moreover, these processes have, for a long time, justly fallen into disrepute.

As to the opinion that the hardness of mortar is due to the regeneration of carbonic acid, I have shown that according to the analysis of Mr. Darcet and Dr. John, several ancient mortars, although very hard, contained but a small portion of the carbonic acid necessary to the saturation of the lime. It has been stated that the Italians sell little caskets and snuff boxes which they make of ancient Roman mortars: but it has been noticed that they use for these purposes only the exterior parts of the mortar in which the lime had passed to the state of carbonate, while the interior often afforded but a weak consistence.

In examining Roman mortars, it is observed that they are often of great hardness, although it is evident that the mixture had been made with very little care. We must therefore attribute the hardness of these ancient mortars to other causes; for, as I have said, all these mortars are not by many degrees equally hard.

To explain the hardness of Roman mortars, it will suffice, I think, to cast the eyes over tables Nos. XXXVI, XL, XLI, and XLII. Table No. XXXVI contains mortars made of hydraulic lime and sand. These mortars

exposed to the air for one year only, show great tenacity. Tables Nos. XL, XLI, and XLII, contain, also, very good mortars made of fat lime, puzzolana, trass, and several kinds of cement. The use of cement goes back to high antiquity, for Roman and Egyptian structures often contain it. Those who wish to solve this question, without recourse to the quality of the lime, or to cements, object that there are ancient remains which appear to have been made of fat lime, since they are seen in countries where no puzzolana or hydraulic limes are to be found, and they have not the aspect of mortars made with cements. I will observe, touching this point, that if we examine the two tables in pages 87, which contain the analyses of several lime stones, we shall see that many limes which are ranked with fat limes contain, nevertheless, small quantities of clay. Although they may not contain enough clay to harden under water, they ought to afford much better mortars in the air than those limes which contain none. Again, hydraulic limestones are often found disseminated amongst the strata of fat lime stones. And, lastly, the important observation of Mr. Girard, on the hydraulic proportions of *arenes* explains easily how very good mortars may have been made of fat lime. I will observe, in addition, that the Romans, in all the countries they occupied, executed a great many works, of which only those made of good mortars survive to the present day. Saint Augustine complains of the manner in which mortars were made in his day: and the same complaints are found in Pliny; who says, chapter XXII, "that which causes the ruin of the greater part of the edifices of this city (Rome) is, that the workmen employ, from fraud, in the construction of the walls, lime which has lost its quality."* We see, therefore, that all the Roman mortars were not good.

For my part, I am convinced, that if those ancient constructions that have reached our times, be examined with attention, it will be ascertained that they were made either with hydraulic lime and sand, or with fat lime and sand mixed with cement, or with arenes: in a word, that these mortars had all the elements of good hydraulic mortars.

We are in the habit of composing our mortars of fat lime and sand; the preceding experiments show that we are wrong: our mortars have, consequently, little durability. We shall not obtain durable masonry in the air, until we make use, therein, of hydraulic mortars. In countries where good natural hydraulic lime is to be had, no other kind should be used for any purpose whatever. For ordinary masonry, the mortar should, in that case, be made of lime and sand only. In countries where there are no natural hydraulic limes, but where there are arenes, the mortar should be made of fat lime and these arenes: in both these cases the mortars would be cheap. In countries where neither arenes nor hydraulic limes are to be procured, it will be necessary to incur a little additional expense, and make use of fat lime, sand, and hydraulic cement. To combine economy and solidity at the same time as much as possible, the proportions, in cases where there are to be one part of fat lime and two of sand and cement, the mixture may be made as follows, viz: one part of fat lime measured in paste, one and a half of sand, and a half of hydraulic cement; (according to similar proportions made with trass, as shown in table No. XXVII,) we should have, by this means a very good mortar. The proportions of hydraulic cement, stated above, should be used in all common masonry: in works demanding more care, the mortar should be composed of lime, sand, and cement, in equal

*We might infer, from this passage, that Pliny complained because the lime was not used soon after its calcination. AUTHOR.

parts. I have said, that the proportions indicated for common masonry, should augment the expense but little: but were the augmentation more considerable, it is certainly much more economical to incur at once, all the expense necessary to produce a permanent work, than to build at a cost rather less in the first instance, and to be obliged to reconstruct the work entirely, after no great lapse of time. A government should construct for posterity: and I do not doubt that this end would be attained by making all masonry with hydraulic mortar, in the manner I have pointed out.

Officers of engineers often have to construct arched rooms, passages, &c., that are to be always covered with earth. The mortar of these constructions is generally composed of fat lime and sand. To resist filtration and humidity, it is customary to place a cap, or masonry roof, made of hydraulic mortar, over these arches: but experience shows that these caps do not fulfill their object, and that they often afford a passage to the water, especially when made of bad cements. I cited an example at page 23, and I might cite many others. Even when the caps are made of good mortar, it may happen that there is humidity in the casemates, and that the arches leak: for we have seen at page 160 that mortars made of fat lime do not dry completely, even in a century, when the walls are thick. And this result is the more certain when the masonry is covered with earth as in casemates. The walls against which the earth lies, almost always allow the water to transude, although the cap may be impermeable. Besides, from the considerable load that these arches often sustain, the masonry that has been made of mortar slow to harden, will settle, causing cracks and leaks in the caps. The only means of obviating these disadvantages, is to construct all the masonry of the casemates with hydraulic mortar. We shall thus secure the great advantage of a prompt induration: the subsidence will consequently be less sensible, and cracks less apt to occur; the walls will no longer allow moisture to transude, and even should there be some cracks in the caps, the water will, with difficulty, find its way through arches made with hydraulic mortar.

The manipulation of mortars designed for exposure in the air, should be the same as that described in the first section for mortars designed for water.

Article xv.—*On factitious Stones and Concretes, exposed to the Air.*

Mr. Fleuret, formerly Professor of Architecture in the Royal Military School, of whom I have before had occasion to speak, published in 1807, a work on the art of composing factitious stones. The following passages are to be found in page 12: "The art of building with factitious stones is very old; it was in use with the Babylonians, and the early Egyptians, amongst the Greeks and Romans, and it is still pursued in Barbary, and amongst the nations of Malabar.

"According to Pliny, the columns which adorn the peristyle of the Egyptian labyrinth, were of artificial stones, and this vast edifice has existed three thousand six hundred years. The pyramid of Nynus is formed of a single block. The enormous stones composing the great and strong walls raised in the empire of Morocco, as is reported by the Abbe de Marsi, from writers whom he quotes; the square stone that formed the tomb of Porsenna, spoken of by Varro and Pliny, which was thirty feet wide by five feet high, were composed in the same manner as the pyramid of Nynus, and lead us to believe that these monuments owe their existence

and their preservation to a process as easy as it is simple, and which unites the advantage of solidity with economy.

"All factitious stones of a volume thus considerable, were made by encasement, and the process of massivation; that is to say, that in the great walls built thereof, these stones were formed the one upon the other, by beating the materials, with rammers, into spaces formed by planks, as I shall explain."

Mr. Rondelet states, in his preface, that the columns of the choir of the church of Véselay, in Bourgogne, were ascertained to be factitious stones by Marshal Vauban, and the pillars of the church of Saint Amand, in Flanders, were made in the same manner.

I have had no opportunity to ascertain whether blocks of stone of extraordinary dimensions, were factitious; this question could not be well settled, except by examination of the masses themselves. It is possible that several of the large blocks mentioned were factitious: but it is not easy to believe, in a wall formed of large pieces placed one upon another, that these large pieces are factitious, for it seems to me that it would be much more difficult to construct a wall of that sort, than to make the whole wall of one piece, whereby the moving and transportation of masses of an enormous weight would be avoided. I do not at all doubt that artificial stones of large dimensions may be made, for all depends on making a good mortar: nevertheless it seems proper not to admit such facts as are cited above without a thorough examination.

The Italians, at Alexandria, make very good factitious stones with the Casal lime, and employ them in angles; they are four feet eight inches long, by two feet eight inches wide, and two feet eight inches high; they are buried under ground for two or three years, and there acquire great hardness. These stones are made in the following manner. For one cubic yard they take 0.24 of Casal lime measured in paste, and 0.90 of sand. These are well mixed together, adding the water necessary to form a paste, and there is then added 0.20 of pebbles, *(cailloux;)* these factitious stones are therefore real concretes. Their goodness depends on the quality of the mortar applied to making them. Mr. Fleuret proposes to make the mortar for these factitious stones in the following manner.

He slakes the lime by immersion, according to the process of Mr. Lafaye, to which he attaches great efficacy. When slaked to dry powder, it is to be deposited in a dry situation, enclosed in casks covered with straw mats loaded with stones. He recommends that, each time the cask is resorted to for lime, a part only of the mat should be raised, and that it be replaced as sooh as possible, in order to guard gainst the contact of the air, which he says is very hurtful. He makes a perfect mixture of sand and clay dust, in the proportion of two measures of sand to one of dust; or, which is better, he mixes sand and dust in equal parts. He then takes two measures of the mixture of sand and dust, and one measure of lime after being tempered with water, and makes them into a heap. He then works them dry, moistening them little by little as they mingle. Lastly, they are taken to a trough, where they are beaten by rammers of wood armed with iron, which are suspended from the ends of poles acting with a spring, like the spring pole of a turner's lathe. Mr. Fleuret says the mortar is improved by wetting it in the trough with a little lime slaked thin, and used in the proportion of one-sixth of the mortar. He censures the practice of reworking the mortar with fresh portions of water, which he says weakens it much.

The author adds that hard stone pulverized, may be substituted for sand,

and that scoriæ, iron scales, and sea coal ashes, furnished by forges, are still better than pulverized stones and clay dust. These are, in brief, the means pointed out by M. Fleuret, for making the mortar he designs for factitious stones. The mortars being made after this process, they are placed in moulds where they are beaten and strongly compressed. Mr. Fleuret has made much use of factitious stone in making water conduits, pump tubes, troughs, &c.

Mr. Fleuret established a manufactory of factitious stones at Pont-a-Mousson. We might suppose that, having at his command the good hydraulic lime of Metz, he would obtain good results; but, as I have said, in the first section, when we attempted to apply this process to making factitious conduits at Phalsburg, and caps of arches at Landau and Strasburg—using the lime of the country, we did not succeed. What I have before stated shows that it is less the manipulation than the choice of materials which affords good mortar, and consequently good factitious stones. But Mr. Fleuret has not given us the means of ascertaining the quality of the materials: and it follows that in pursuing the path he has pointed out, we are exposed to bad results, as happened in the above cases.

According to the experiments I have made, the best process for making mortars to be used in forming factitious stones is, if we use hydraulic lime, to slake it to powder with about one quarter of its volume of water, and to cover it with the materials that are to be mixed with it. I have several times remarked on the importance of making the mortar soon after the slaking of the lime. We ought not therefore to slake more lime at one time, than will suffice for eight or ten days. If the lime be eminently hydraulic, sand only need be added; and, of sand, that which is fine should be much preferred. If only a mixed sand can be had, it should be passed through a fine sieve; if it be too coarse, it should be pulverized; and if it be earthy, it should be washed by the process I have given.

If the lime be only moderately hydraulic, it will be necessary to make the mortars by adding to the lime equal parts of clean fine sand and cement.

If we happen to be in a country where the only lime is fat lime, we have seen, by table No. XXXIII, that it is quite immaterial whether this lime be used as soon as it is burned, or after having been slaked for some time, to paste or powder. Care should be taken to use only hydraulic lime made of clay, which contained but little lime. The mortar will be made by mixing the lime with the quantities of clean fine sand and hydraulic cement which shall have been found by trial to be the proportion best suited to the lime. In general, the proportion of one part of fat lime measured in paste, to two, or two and a half, of the other ingredients, will afford a very good mortar. There will be no disadvantage in wetting the mortar sufficiently to cause it to work easily, nor in reworking the mortar with a little additional water, should it become too dry. An excess of trituration is useless; it is sufficient if all the materials be well mixed. All my experiments show that iron does not improve mortar. The scoriæ, and the ashes of forges should not therefore be used without our being satisfied before hand, by the means I have pointed out, that they are hydraulic.

When the hydraulic mortar of which the stones are to be formed, has been made as above, it should be placed in moulds, if the stones are to be of small dimensions, and should be loaded with weights, or submitted to heavy pressure, until it has acquired sufficient consistence to be withdrawn from the moulds without breaking. The stones are then to be deposited in a moist place for about one year.

When factitious stones are made for water conduits, or other objects that are to be buried under ground, there is no objection to using red cements, such as are generally made from brick earths; but this colour would be disagreeable to the eye; and in case the objects are to be exposed to view, cements derived from clays that do not take this colour from burning should be used; such, for example, as are used in making tobacco pipes, stone ware and crockery. With the same view, cement derived from slate may be used.

There is no doubt in my mind that with good mortar, factitious stones may be made which will afford, at the end of a year, a resistance approaching that of ordinary bricks, and that the strength will go on increasing with time. We find in the Annales de Chimie, Vol. XXXVII, that "Mr. Monge, in visiting the ruins of Cesaria, remarked, in a temple consecrated to Augustus, that the pillars had wasted away to a great depth, but that the mortar projected. He tried in vain to break off a piece. The mortar was of very fine and equal grain; it appeared to be composed of fine sand and very little lime, very well mixed." It has been remarked that in the ancient Roman constructions which still exist in the Northern districts, the mortar has perfectly resisted the inclemencies of the seasons. I made at Strasburg large cubes of hydraulic mortar, which I withdrew from the water after about one year, and left exposed to the air during several summers and winters without their sustaining any injury. In the 7th No. of the *Memorial de l'Officier du Genie*, it may be seen that I proposed in 1819, to cover with factitious stone the floor of a sluice *de chasse*, which was 100 feet wide and was composed of five passages. The foundation was of concrete, and it was covered with a layer eight inches thick of good hydraulic mortar, which became united to the concrete, formed a factitious stone, showing, the next year, great solidity. It has now been made ten years, and it has sustained no injury. This means may be used with great advantage in countries where there is no good stone for cutting, or where such stone is dear.

In countries where free stone is not to be obtained, it is very advantageous to be able to compose factitious stones to form the angles, copings, casements of doors and windows, cornices, gutters, water conduits, &c.; this mode of fabrication might even be applied advantageously to objects of the largest dimensions. It often happens that for bridges across the ditches of fortifications, pieces are needed of about three feet in thickness: where stones are not to be had of suitable quality, these pieces may be easily made on the spot in a single piece of factitious stone: under similar circumstances, piers of sluices, columns, and obelisks may, also, be made; but in the cases of such large masses, it will not be easy to bury them in the first instance, and afterwards place them in the proper situations. It will be best, therefore, to construct them on the spot. It does not seem to me to be indispensable to make plank moulds to give them their proper shape: forms such as are used to direct the construction of walls, would suffice. It would only be necessary to take care, when the mortar had been made of ordinary consistency, that it should stiffen a little before being used, so that on being spread with the trowel it would retain the form given it, and at the same time be so ductile as to spread easily and unite itself well with the previous layer. As this mortar dries very quickly, there is no danger that the work of the morning will give way under the pressure of that of the afternoon. After having finished the day's work, care should be taken to cover the top of the wall with wet straw matting, so as to maintain a favourable humidity; in the morning the surface of the mortar should be rammed with a small flat

rammer, and be made slightly wet, so as to be somewhat softened and brought into proper state to unite with the succeeding layer. As the work rises, care must be taken to surround it with straw, or some similar substance, which must be kept always moist during the first summer. If the work have but little altitude, earth may be banked against it. In all constructions of this kind, it is proper to make the work with a little excess of dimensions, so that the following year some tenth of an inch of the outside, which, having dried too quickly, will be less hard than the interior, may be cut away; pressure should always be applied, in any way most convenient, where the nature of the structure will permit it.

If it be thought proper, these factitious stones may be coloured at the time they are made, by mixing in the mortar composing the surface, some suitable metallic oxide.

If the factitious stones are to be of large dimensions, gravel or small stones may then, for the sake of economy, be mixed with the mortar: in such cases the resulting mass will be concrete. This substance was used by the Romans: several of their works are found in which the faces of the walls are of stones, and all the interior of a mixture of mortar and pebbles. Mr. Fleuret having enumerated, as stated in the beginning of this chapter, the great monuments supposed to have been made of factitious stones, says "There are even great walls constituting the enclosure of towns, large aqueducts, and piers of bridges, still remaining, nearly entire, from the time of the Romans, of which the faces are made of very small stones, and the heart of the wall of pebbles mixed with stones larger or smaller, thrown at hazard between these light facings. This masonry made of fragments, and rammed in an encasement, becomes but a single mass, and is rendered so compact by continuity, that in a short time the walls becomes indestructible."

I do not think that this masonry was made in encasements; the facing walls were substitutes therefor; and had there been no facings, the concrete, as I have before observed, might have been built up without moulds. But we see by the quotation, that the Romans made much use, in constructions in the air, of small materials mixed with their mortar, and it is this kind of construction which, as I have said, we now call concrete. I have stated, in the first section, that in repairing, in 1816, one of the dams which sustained the navigable canal of Strasburg in its passage across the ditches of the fortification, I found that the facings alone were of free stone, and that all the interior was of concrete, of great hardness, which led me to presume it had been made of hydraulic lime, and induced me to make researches, whereby I became possessed of the qualities of Obernai lime, and afterward of many other hydraulic limes in the neighbourhood.

In constructing with concrete the interior of baterdeau that have sufficient thickness, we may be certain of their great durability. In rubble or regular masonry, the mortar does not always unite itself perfectly to the stone—so that if there be a head of water, it will at least find a passage between the joints. This cannot happen in masonry made of small materials, as concrete, because all these small stones are separated from each other by a portion of the mortar which will oppose filtration. In the two baterdeaux of Strasburg which I have cited, the facings were displaced; but the central mass of concrete prevented a single drop of water from passing, notwithstanding the bad condition of the facings.

Mr. Rondelet says at page 116 of his work "There is found near Metz in France, a very hard stone with which they make lime of very superior quality; this lime, newly slaked and mixed with gravel, affords a concrete

or species of mortar, of which the consistence is so great that arches may be constructed of it, without bricks or stones; these arches form a single piece as hard as stone.

Lieut. Col. Finot has constructed at Strasburg, within two years, an arch of concrete of about thirteen feet four inches diameter, which has succeeded well: the piers are of masonry. A similar arch has been coustructed at Schelestadt. This kind of arch offers great advantage in many circumstances.

When the arches are to be underground; this will be the best means of preventing filtration; but that the underground room may be perfectly dry it will be necessary to make the piers and end walls also of concrete.

It often happens that there are casemates and cellars which in time of floods, fill with water. This may be prevented by putting a structure of concrete upon the bottom: and if the water filters through the walls, by reinforcing them with a plaster of concrete. By these means we turned to profit, at Strasburg, several casemates, of which the floor was below the level of the water in the river, and in the ditches, in time of floods.

We are frequently obliged to carry a canal over a stream of water, and vice versa. In such cases aqueducts are built. It is here particularly, as in aqueducts in general, that concrete is indispensable. If it be thought proper to build the arches of stones or bricks, it is indispensable, in order to resist filtration, to make all the masonry above the arches, of concrete. In countries where proper materials for making the arches cannot be obtained at a reasonable rate, it will be advantageous to make the arches of concrete, in which case the aqueduct will be formed of a single piece. Arches of large dimensions may be constructed in this way, either for aqueducts or for ordinary bridges.

It is necessary sometimes to enlarge a wharf, in cases where the river cannot be restricted; and it is done by making all the courses of masonry, projecting, or corbel, courses—a very expensive construction, on account of the large dimensions which the stones must have. The same result may be obtained with concrete, which will form but a single piece of great solidity, at small comparative cost. By similar means *machicoulis*, which are sometimes necessary to protect the entrance to forts, may be made.

Researches are now being made as to the means of preserving grain in *Silos*. It is requisite to success, that the grain be preserved from the contact of the air, and from humidity. Both these conditions will be secured at the same time, by making the *Silos* of concrete. After the grain is deposited therein, it may be hermetically sealed by closing the mouth with the same substance. *Silos* may be of great advantage in provisioning fortified places: and it is important that attention be directed towards them.

In some departments in the north of France, no good building stones are to be found, and revetment walls are there constructed of fragments of chalk, there being a facing of bricks to preserve the chalk from contact of the air. But in several of these places the bricks are of bad quality, and this facing scales off, requiring considerable, and perpetual, outlays for repairs. In such circumstances it should be, I think, advantageous and economical, to build the revetment entirely of concrete. It should be composed of hydraulic mortar in which would be mixed gravel, fragments of chalk, bricks or any similar matters, in the proportions indicated in the first section. Taking care to apply on the outside a thick plaster of the same kind of mortar. The plaster should be applied at the time the con-

crete is laid, so that it may unite with it perfectly. By this means the chalk will be preserved from contact of air. As the wall rises, humid earth should be placed against the back of it, and the front should be covered with straw-mats or a thick layer of straw, which should be kept wet during all the first summer. In countries where good *arenes* are to be had, revetments in concrete would not be dear; and, besides the advantage of avoiding considerable expense in repairs, it would be more difficult to make breaches in revetments of concrete than in those constructed of stone.

I will observe that in the construction of revetments, which have, commonly, about thirty-three feet in height, and sustain a great mass of earth, the bad quality of the mortar often makes a much greater thickness of masonry necessary than if the mortar were good. By making, as I have proposed, all the masonry of hydraulic mortar, the expense will be augmented a little; but on the other hand it will be possible to diminish the thickness of the walls, which will be a compensation. By making the revetments of concrete they will be of a single piece, and the thickness may be sensibly reduced; which will amount to a great saving wherever good arenes are at hand. Nothing would prevent these revetments being made with counterforts or with relieving arches.

In the south of France particularly, are to be seen revetments of great exterior slope. This mode of construction, permits the thickness of masonry to be considerably reduced: but it cannot be adopted in the north, because of the humidity which favours the development of vegetation in the joints, causing the ruin of the masonry. By constructing these revetments with concrete, taking care to apply a strong exterior coat of plaster immediately, and to unite it perfectly with the beton, there will be nothing to fear from vegetation, and the talus of the wall will allow its thickness to be considerably lessened. This will be worthy of trial at those places in the north where the materials are not generally good, and where arenes are to be obtained.

When repairing revetments from which portions had scaled off, from the effect of vegetation, I had occasion to remark that sometimes the lime seemed to have disappeared from the mortar almost entirely; to such a degree that it was thought the lime had been fraudulently reduced in quantity in making the mortar. Examining these separated parts of the wall, I remarked that all the joints of the stones were filled with roots which had penetrated to a great depth. There remained hardly any thing but sand in the joints of the stones. I was led to believe from this that fat lime is absorbed by vegetation. I saw no such effect in masonry made of good hydraulic mortar. It is possible that the hardness of these mortars resists the development of vegetation; or that this kind of lime is less favourable than fat lime. In making revetments of concrete, giving them a good coat of plaster made of hydraulic mortar, of which the surface should be made very smooth, it seems to me that there would be nothing to fear from vegetation.

In the northern department of which I have spoken, the buildings are not more solid than the revetments. They are obliged to make them of bricks which are at the same time of bad quality and very dear. In many southern districts houses are made of *Pisé*. This kind of construction is not in my opinion solid enough for military establishments; and I doubt if it would succeed in the humid climate of the north: but I see nothing to prevent these buildings being made of concrete. I have shown that with

hydraulic mortar we obtain a strength approaching that of common bricks. The walls of houses constructed of concrete containing this kind of mortar would possess great solidity, and wherever arenes were at command and building materials bad, would be erected with great comparative advantage. The angles of the building, and the casements of doors and windows, should be made of factitious stone, and the walls should be covered with a coat of hydraulic mortar, coloured to resemble stone. The precautions indicated above, against too rapid drying, should not be omitted. It would be easy to make a trial of this kind, on some small building, or a guard room, kitchen, &c.

We often have to construct bomb proof buildings, for powder magazines, barracks and other establishments. In countries where the mortars are of bad quality, I am of opinion that it would be wrong to make them of concrete. When made of stones, or bricks, I have already said, that it seems to me necessary to use hydraulic mortar. I will add that when it is thought proper to make the arches of stones or bricks, I regard as indispensable, after the centre has been struck, to make all the masonry above these arches of concrete; this being, in my opinion, the only means of securing their future impermeability. This mass of concrete might, in fact, enable us to dispense with a plastered cap; but, for greater security, it will be best to put on a coat of plaster of about one inch in thickness. It is very important when these caps are in progress, to shield them from the sun. They are sometimes covered with a sail cloth; but this does not preserve them from hot air which causes them to dry too quickly. It would be better and cheaper, to cover them, as they advance, with moistened straw. When the caps have acquired sufficient consistence, they should be polished, and again covered with straw, which should be kept moist all summer. If the arches are to be covered with earth, this earth, at least in part, should be put on as soon as the caps have been polished.

There is still another use to which concrete may be applied with great advantage, namely in the abutments of suspended bridges. When there is not rock to which to attach the chains, it is necessary to build abutments; but these chains acting in an angle of about 45°, a great part of the tension is in a horizontal direction. If the mass of the abutment is of cut stone; or rubble masonry, the mortar not fastening the stones together strongly, this force may disjoin them horizontally. This lately happened to the suspended bridge built opposite the *Invalids* at Paris. I do not doubt that the masses of masonry forming the abutments would have been competent to resist a much greater force than they were subject to, if those abutments had been of a single piece each: but as they were constructed of cut stone and rubble masonry, and there had not been time for the mortar to dry thoroughly, the masonry separated into two parts near the middle of the abutment, so that the hand might be introduced between them. This I consider the explanation of the accident which made it necessary to demolish the bridge before it had been entirely uncentered. If the masses to which the chains were fastened had been of concrete, they would have formed a single, homogeneous, inseparable mass: it would have been necessary for the chains to have drawn it off entirely, or to have broken it, while, in the actual case, it was only necessary to disjoin stones that had but recently been united by mortar. When bridges of this kind are built it seems to me proper to make the abutments, to which the chains are to be attached, of concrete: and they should be erected a year in advance so that the substance may acquire sufficient solidity.

The beginning of autumn is the most favorable season for making concretes that are to be exposed to the air.

I will conclude by observing that the expense necessary to the composition of good mortars for concretes, must be encountered. In countries where the arenes are not very hydraulic, they may be mixed with hydraulic cement in proportions depending on the energy of the materials. As I have said above, it is more economical to encounter the requisite expense of good masonry, at once, than to execute it cheaply of bad materials.

I have thought it proper to enter into some details as to the advantageous use to be made of concrete in places where building materials are of bad quality; and to indicate some new modes of construction to be substituted for those now in use.

Article xvi.—*Summary of the Second Section.*

The experiments reported in the second section of this memoir, lead me to the following conclusions, as to mortars exposed in the air.

When I made mortar by using fat lime that had been lying slaked and moist for a considerable time, and sand only, I could obtain no satisfactory result, whatever were the proportions. In making mortars with sand, and fat lime just from the kiln, I could obtain only mediocre results. The lime I used was got from a carbonate of lime containing only a minute quantity of iron. It will be important to ascertain, whether, as I anticipate, similar results will be produced in other countries. Should the experiments in other places afford similar results, it will be necessary to abandon the practice of keeping fat limes lying slaked and wet for a long period, and to adopt that of using them fresh from the kiln.

The process of slaking lime announced by Mr. Lafaye, and that given by Mr. Loriot, afford no sensible amelioration with fat lime.

Hydraulic limes mixed with sand, produced very good mortars in the air, as well as in water. These limes must be used soon after the calcination, as they lose a great part of their energy. Mortars made of hydraulic limes afford a greater resistance when they are mixed with sand and hydraulic cement, than when mixed with sand only. Hydraulic cements, or other analogous matters, mixed with limes, restore the energy of those which had been too long exposed to the air; and augment the energy of those which are but moderately hydraulic.

Hydraulic mortars made of fat lime, sand, and hydraulic cements, or other analogous matters, are excellent when used in the air. When sand and cement, in equal parts, are added to lime, it is almost a matter of indifference whether the lime be used fresh from the kiln, or slaked to powder with a little water, and for some time exposed to the air in this state, or, having been slaked and lying wet for a considerable time. But if only a small quantity of cement is to be added to the mortar, it will be best to use the fat lime shortly after its calcination.

In countries where good natural hydraulic limes are to be had, they may be used with sand only, in making mortars for exposure to the air. When such limes are not to be found, instead of making artificial hydraulic limes, it will be preferable, as in the case of water mortars, to make the hydraulic mortar directly, by mixing fat lime with sand and hydraulic cement. The proportion of cement to be mixed in the mortar will depend on its quality, and the nature of the works to which it is to be applied.

Clay dust containing about one-fifth of lime appears to be less proper

for mortars that are to be exposed to the air, than for those to be placed in water: but a few hundredths of lime, far from injuring, have an advantageous effect in saving fuel, and facilitating the pulverization of burnt clays. Clay dust, and other analogous matters, should always be made very fine.

Arenes mixed with fat lime afford hydraulic mortars, which are very good in the air. When the arenes are feeble, they should be mixed with a little hydraulic cement.

When *clay dust, ashes, scoriæ of forges*, and *arenes*, have only weak hydraulic properties, they give to air-mortars but feeble tenacity. Before using these matters in the air, therefore, they should be tried by mixing them with fat lime, and plunging them in water, according to the process given in the first section. It is the more important to make such trials, because these substances are very dear, and some varieties of them produce no better effect than so much sand.

Fat lime and hydraulic lime do not seem able to bear as much sand as is commonly thought. Fine sand affords much better results than coarse, both in air-mortars and in water-mortars. Earthy sands must be avoided. In places where earthy sands, only, can be procured, they must be washed: but before resorting to this operation, we should be satisfied that these sands are not arenes. Should they prove to be arenes, they must be used in the state in which they are found.

The process given in the first section for the manipulation of water-mortars applies equally to air-mortars. No ill consequences need be apprehended from wetting the mortars to the degree requisite to their being worked with ease; nor, when they have become too stiff, from exposure to the air, from adding a little water, on reworking them. An excess of trituration, beyond what is required to mix the ingredients thoroughly, is altogether useless.

It does not appear that the Romans had any particular process for making their mortars. No masonry has survived to our day but such as was made of hydraulic lime, or of fat lime and hydraulic cements, or arenes (I speak here of masonry made of small materials.) An inspection of their mortars shows that they were often made with little care, proving that their good quality is to be attributed solely to the quality of the lime, or of the substances mixed with it.

If, in general, no better results are obtained with fat lime, than those obtained by me, the practice of making mortars of fat lime and sand only, should be abandoned. A small quantity of hydraulic cement, or of some substance of similar nature, should always be mixed in the mortar; that is to say, all air-mortars should be hydraulic mortars. The expense will be a little greater it is true, but there will be full compensation in the duration of the masonry. There is no economy in putting up cheap masonry which will require to be rebuilt at the end of a few years; and will need costly repairs, annually: it is much better, and really more economical, to encounter, at once, the expense which will secure to the work an indefinite duration, and exemption from all but trivial repairs.

Hydraulic mortars, whether made of hydraulic lime and sand, or of fat lime and hydraulic cement, or other similar substance, resist the inclemences of the seasons well, which makes them proper to form factitious stones. The art of making factitious stones is nothing more than the art of making good hydraulic mortars. This kind of stone may be easily made to possess, at the end of a year, a tenacity about equal to that of ordinary bricks, and

this tenacity will go on augmenting, for several years. The solidity of hydraulic mortars is favoured, and of course the solidity of factitious stones also, by keeping them moist during the first year. They should, therefore, be buried under ground, or placed in water, if their dimensions will allow; and when too large to be thus disposed of, they should be formed on the spot they are to occupy, and be enveloped in some material which may be kept wet. It would be proper to make their dimensions a little in excess, in order to bring them, subsequently, to their true dimensions, by cutting away the surface that had been in contact with the air. In order to avoid disagreeable colours, cements should be taken, which are but little coloured by the oxide of iron.

In countries where building materials are of bad quality, and where energetic arenes, or good hydraulic limes, are to be had, concrete may be advantageously employed, in the construction of revetments, underground rooms, aqueducts, and various buildings: this mode may also be employed, even where no arenes or hydraulic limes are to be found, provided the materials for making cements, can be procured at a moderate price.

It will be important, wherever works in masonry are to be carried on, to make experiments in order to ascertain, 1st, the quality of the several kinds of lime to be found in the neighbourhood; 2nd, whether it be best to use fat lime fresh from the kiln, or to slake it into vats, and allow it to lie for some time wet, as is commonly done; 3rd, the proportion of sand that gives the best mortar; and 4th, the quality of various arenes and cements to be found in the vicinity.

To make these various experiments, both for water-mortars and air-mortars, I think the essays should be submitted to trial, after about one year, with a machine like that used by me, and of which a drawing is added. It would be advantageous to make, in all places, the trials with prisms of mortar of the same dimensions, in order to compare the various results, and to ascertain the relative qualities of the materials, in different districts or countries. The great number of experiments I had to make, was the reason why I used prisms too small. I think that quadrangular prisms 14 inches long by 4 inches, (0.35m $\times$ 0.10m $\times$ 0.10m) would be of suitable size.

To this end the mortar should be moulded in boxes 14 inches long by 4.80 in. wide by 4.80 high: after a year, four-tenths of an inch should be cut from each face, and the prism be placed in two stirrups of iron, like those in the plate—the stirrups being twelve inches clear distance apart, and be broken in the manner pointed out in the first section. Similar prisms should be made of the best brick earth in the vicinity, which, after being burned, should be cut down to the same dimensions as the mortar prisms; these brick prisms being broken, the average weight sustained by them will serve to appreciate the resistance of the mortar prisms. Stone prisms should also be subjected to the same trial: these, when of good stone, will show a strength much beyond that of the best bricks: I doubt if mortars can be brought to afford a resistance equal to hard stone: but the strength of bricks may be easily attained, and that will give good masonry.

I must urge upon Engineers to study, in their several localities, the materials most proper to make good mortars. The fabrication of mortars has been, for a long period, abandoned to a routine which has produced perishable masonry, requiring frequent repairs; and thus consuming funds which might have been applied to the construction of new work or the amelioracion of the old. Engineers should not consider it beneath them to be occupied in this kind of research: and they should leave behind them at each

place, a relation of the experiments they have made, and the results they have obtained. These operations require minute attention, certainly, but this will be recompenced by works of long duration.

(TO BE CONTINUED.)

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Mechanical power of the Pulley; in reply to the strictures signed G.

By L. H. Parsons.

Accompanying my essay on the "Mechanical power of the Pulley," in the October number of the Journal of the Franklin Institute, is an article, signed G, in which the writer assumes and professes to show, that I "labour under some misapprehensions" in supposing that the *movable pulley* is referable to the second kind of lever. The remarks are of such a character as appear to me to call for, and I presume I shall be allowed, a few words in reply.

After intimating that my piece was inserted as a matter of sufferance, the writer complains of the want of clearness in the expression of my views. I certainly regret that I failed of making my views intelligible,—for I cannot but flatter myself that the writer of the article, as well as every other reader, would, if he had understood my reasoning and illustrations, have agreed with me. I regret also, that he did not point out the passages, containing the obscurity of which he complains; so as to give me an opportunity, if possible, of making the matter clear.

At present, I do not feel called upon, or even at liberty, to attempt any further exposition or defence of the principle which I undertook to establish:—for my reasoning has not been answered, or even a single point alluded to by G. Whether sound or fallacious, the whole of it remains untouched. I attempted to show that a *movable pulley*, connected at one side with a stationary cord, and at the other, with the power, operates upon the principle of a lever of the second kind; also, that the same holds true with a cord passing over a solid body *without* a pulley. Instead of pointing out any fallacy in my reasoning, or, in any way, showing that a real pulley *does not* act upon that principle, G. supposes an "imaginary machine," in which, to use his own language, "the points considered as the points of application of the power and weight respectively, *coincide!* and of course, move through equal distances, in equal times," and concludes that "here there is no lever." Very true; and what is there, I ask, in this "imaginary machine" that can claim any resemblance, even in theory, to that known by the name of the pulley? I must confess that I can discover nothing. If the points referred to, *coincide*, and coincide they must by the supposition, the machine (if it be called one) is neither more nor less than a single line attached to a weight. Consequently, no reasoning in regard to it, has any thing to do with the subject in hand. If by supposing all the parts of the machine to be reduced to a single mathematical point, it can be shown that the *pulley* is not a lever, then by the same process, it can be proved that the *lever itself* is not a lever. Instead of "an infinitely fine wire," why might I not as well suppose an infinitely short bar or rod, and then say that "here there is no lever, since the points before considered, as the points of application of the power and weight (and fulcrum also) respectively, now coincide, and of course, move through equal distances in equal times."

For myself, I can conceive of no use in thus refining the matter down to an infinitesimal, even if the supposition did not destroy, or affect, the essential elements of the machine; which, however, it certainly does, in the case before us. Why not suppose a real, or at least a possible machine? Suppose a real bar (I care not how short, provided it has sufficient length to admit of a point lying half way between the two ends, and not *coinciding* with them) with one end suspended by an immovable cord, and the other by one that is movable, or by the hand; and then suppose a weight to be attached to the centre of this bar; (see the bar A, C, in the diagram, page 244) will G. say that "*here* there is no lever? "If not, will, or can any difference be pointed out between it and the movable pulley? If G. will procure (as I have done for the purpose of experimental illustration before a class) a pulley, five or six inches in diameter, with a straight bar of similar length, attached to its side, the centre pivot passing through both the bar and the pulley, and the apparatus so constructed that the cord may easily be removed from the edge of the pulley and attached to the ends of the bar, I have no doubt he will admit the existence of the principle in question.

G. says, "several authors have explained the relation between the power and the weight in the single movable pulley, on the principle of a lever of the second kind. I am aware that some authors have spoken of it in general terms, as being a lever; but I had supposed that the stumbling block always consisted in neglecting to transfer the fulcrum from the centre to the periphery of the pulley. I should be glad to be referred to an author who expressly assigns the fulcrum to the point where the stationary cord comes in contact with the pulley.

Not long since, I received a communication (in reply to some suggestions of mine on this subject) from a learned Professor, who is the author of a valuable and popular treatise on Natural Philosophy, in which he explains the pulley in the usual way. He expressly admits that "the movable pulley is a lever of the second kind, where the power is applied twice as far as the weight from the fulcrum;" but he does not consider the matter of sufficient importance to call for any change in the rationale. For my part, I think truth should he preferred to error, even in the most trifling matters, especially in Philosophy; and even though old associations and the sanction of great names, be on the side of error. But a subject, involving a fundamental principle in Mechanics, cannot be considered trifling.

Having pointed out what I conceived to be the irrelevancy and unsoundness of G's. strictures, I have now in conclusion, only to say that I am willing to leave the argument, just as it is, in the hands of my readers, with this single request—that they re-examine, carefully, the two articles, to which this communication has reference. Let the enquiry commence, (where it ought,) with the thing itself, a real machine, instead of that which has no actual resemblance to it, a non-entity, and I have no fear for the result. If any defect can be detected in my reasoning, or any unfairness in my illustrations, I expect and desire it to be exposed.

November, 1837.

Remarks.—The foregoing communication, from some cause unknown, was not received at the Institute till it was too late for insertion in the last number. Whatever may have been the impression produced by the observations on the former paper of Mr. Parsons, certainly nothing more was in-

tended than an attempt to rectify what was conceived to be "some misapprehensions" into which he, in connexion with many others, have fallen with regard to the best mode of reasoning in demonstrating the theory of the pulley. The question at issue is considered as worthy of philosophical discussion, and the writer of these remarks does not doubt from the last sentence of Mr. Parson's communication, that, as an instructor, having a high regard for the truths of science, he will duly appreciate every attempt, fairly designed, to render those truths triumphant.

The want of clearness to which allusion was made, occurs in the second paragraph of page 244, in which it is asserted that the cords, though "practically indispensable," are not "theoretically, an essential element." It is doubtful whether the author means to convey the opinion that an elementary notion of a pulley could be given to a pupil without the supposition of a determinate *flexible* connexion between the two points to which he wishes principally to direct the attention, viz: the two extremities of his lever. How the fulcrum of the straight bar which (as he states above) he attached to his pulley, was made to ascend, during the experiment, he does not inform us. If it truly represent any given diameter of the pulley while in motion, it must necessarily descend, and without a constant downward motion of the imaginary fulcrum, no motion of the weight could ensue. But is not a constant motion of the fulcrum inconsistent with the *elementary* notion of a lever? If the weight *constantly* rise, what is the "time being" during which the fulcrum is "vertically stationary?" To make out a case, therefore, it seems that he has at last to come to "infinitesimals," and this appears at least as objectionable with respect to time, as to space or distance.

If it be alleged that a constant movement of the fulcrum is not incompatible with the definition of a lever, provided the motion of the weight and the power be relatively more rapid, as in the rowing of a boat, I would still urge, that as a dynamical machine, the oar would be *more* effective were the fulcra fixed points, as they might be were the boat in a canal so narrow that the oars could reach the shores, and lodge at every stroke against a fixed obstacle; and that just in *proportion* to this stability is the oar to be considered as a lever of the second kind, and no farther. The idea of a *perfectly* unstable fulcrum seems to me to divest the lever of the attribute of power, and that an imaginary condition of simple statistical equilibrium is an insufficient postulate as a basis of reasoning in a case like the present.

But the error (if it be one) of considering the movable pulley as a lever of the second kind is not peculiar to Mr. Parsons. As he wishes a reference to authors that have so considered it, I quote a few of those which happen to be at hand, merely changing the letters in their references to figures, to suit the one given by him in his first communication in the last Vol. page 244.

"The movable pulley is fixed to the weight W, and rises and falls with it. In comparing this to a lever, the fulcrum must be considered as at C; the weight acts upon the centre D, and the power is at the extremity of the lever A. The power, therefore, being twice as far from the fulcrum as the weight is, the proportion between the power and the weight, in order to balance each other, must be as 1 to 2."—*Imison, Elements of Science and Arts, Vol. I, p.* 51.

"We have now to show that the movable pulley acts like a lever of the second order. Let the movable pulley be fixed to the weight W, with

which it rises and falls. In comparing it with the lever alluded to, the fulcrum must be considered as at C; the weight acts upon the centre D, by means of the neck D H; the power is applied at A, and the line A C will represent the lever."—*Smith's Panorama of Science and Art, Vol. I, p.* 308.

"Maintenant la droite A C peut etre considerée comme un lévier du deuxième genre; son point d'appui est en C, la puissance est censée agir en A, et la résistance se fait sentir en D dans le sens vertical D H."—*Mollet, Mécanique Physique, p.* 366.

"When used in this manner, (the fixed pulley,) the pulley is but a method of altering the direction of the applied force. But if inverted, so that the end of the line E is attached to a fixed point, the weight or resistance being at D, and the applied force acting upwards, the line from E being permanently fixed, it will become a fulcrum; and the horizontal radii of the circle assume the position of a lever of the second class," &c.—*Nicholson's Operative Mechanic, Phil. edit. p.* 11.

"A C represents a lever of the second kind, whose support is at C, a fixed point; the rope C E being fixed at E. And the weight W acting at the middle of A C, and the power acting at A, twice the distance from C; therefore the power P is to the weight W as ½ A C to A C; or as 1 to 2."—*Emerson's Works, Vol. VII.*

"This power (the pulley) may likewise be explained on the principle of the lever. If the pulley is fixed, it is a lever of the first kind; if movable, it is one of the second kind.

"In the movable pulley the power is applied at A, the weight at D, and the fulcrum is at C; therefore since the length of the arm A C is double that of D C, a power P applied at A will sustain a weight W applied at D twice as great as P."—*Willit and Smith's, Elementary Treatise on Nat. Phil. Philad.* 1830, *p.* 44.

In conclusion I cannot but agree with the author of the treatise on mechanics in the "Library of Useful Knowledge," "that such investigations (establishing the conditions of equilibrium by considering it as a lever) are founded on wrong principles, although their results happen to be true;"—and with Dr, Gregory in his treatise on mechanics, Vol. I, p. 88; who states, with approbation, that "Professor Hamilton and others have been of opinion that the pulley cannot properly be considered as a lever of any kind."

G.

For the Journal of the Franklin Institute.

Result of some experiments on Temperature, connected with the use of Prof. Olmsted's Stove. By J. Griscom.

Since the introduction of anthracite coal as one of the main sources of domestic heat in a large section of the United States, the number and variety of contrivances for facilitating its combustion are scarcely less amusing, than were the numerous determinations of its total unfitness for the purposes of a common fuel, and the numerous grates that were pulled down, after giving it, as was supposed, a fair trial. The success which has since attended the use of this material, the demonstration of its admirable adaptation to all the wants of the parlour, the bed room, and the kitchen,—its extensive employment in manufactories, and the vast enterprise now manifested in the exploration and transportation of

it, are flattering evidences of the skill and energy with which obstacles are overcome by our citizens, and the bounties of nature, so lavished upon our country, turned into the channels of its prosperity.

No species of fuel hitherto tried by man, of equal calorific power, can be compared with the anthracite of Pennsylvania, for the combined qualities of cleanliness, durability, and economy of time and money. The recent application of it to the reduction of iron ore, seems to form a climax in the discovery of its beneficial qualities. But we know of no fuel which requires so much judgment in the proper management of it. Its great compactness demands a nice regulation of the draught, and admission of the air requisite to maintain its free combustion.

For the purpose of saving fuel, and consequently the labour and trouble of attendance, stoves are preferable to open grates. They are also much more effectual in keeping up the temperature needful to entire comfort in cold weather. In a properly constructed stove, no heat is absolutely lost, for no more need be allowed to escape into the chimney than is necessary to support the warmth of a column of air a few degrees above that of the external atmosphere, in order to produce a sufficient draught. The equable diffusion of heat throughout an apartment, is best accomplished by a spreading jet, or column of heated air, and when this can be combined with the operation of a stove, it is difficult to perceive, so far as the production and diffusion of heat are concerned, what further improvement is to be expected.

Without pretending to much practical information relative to the numerous modifications, patented or not patented, which have been given to stoves for the purpose of burning anthracite, I would state, that having occasion to make a selection, I resolved to try the stove of Professor Olmsted, not with a view to assert its superiority, but by a register of its effects, to furnish data from which any one may draw conclusions satisfactory to himself.

My room, which is used both as a study and a sleeping room, is about eighteen feet square. The house is situated on elevated ground, between nine and ten miles from Philadelphia, on the Columbia Railroad. The stove, or furnace, is a cylinder of Russia sheet iron, lined with fire brick. The internal diameter is eight inches, and the height of the cylinder from the floor is two feet seven inches. It stands two feet nine inches from the chimney, the pipe passing through the chimney board of a small fireplace. The stove is connected laterally, with a double cylinder or drum, of similar sheet iron, into which the draught is turned as soon as the fire is well kindled, by closing a damper in the pipe. This drum or radiator, together with the pipe, increases the area of heated surface, in addition to that of the stove or furnace, to about eighteen square feet. The thermometer in the room hangs against a partition wall at the distance of about twelve feet from the stove, and four and a half from the floor. This was regularly compared (in the following table) with a thermometer in a northern exposure on the out side of the house.

Date 1838.	External Thermometer.			Internal Thermometer			Pounds of coal consumed.
	Morn.	Midday.	Even.	Morn.	Midday.	Even.	
	Degs.	Degs.	Degs.	Degs.	Degs.		lbs.
Feb. 11	19			62			
12	26				66		30
13	25			50			30
14	21			57			31
15	10	18	15	56	63	64	
16	20	20	19	46	60	60	30
17	8	18	14	44	62	64	32½
18	14	24	20	43	65	64	34
19	24	28	17	45	68	66	31½
20	15	22	10	45	70	66	32
21	3½	18	12	43	68	64	31
22	9	26	16	55	68	62	32½
23	14	26	24	52	66	64	
24	18	22	12	58	70	68	31½
25	6	18	12	54	72	66	31½
26	7	26	11	45	66	70	31
27	11	32	18	52	67	68	30
28	8	24	24	49	74	62	31
March 1	13		24	49		66	32
2	20	32	22	56	66	70	
3	15	35	22	49	66	66	32
4	18	40	26	49	72	66	32½
5	32	44	36	55	69	71	
6	34	48	37	53	66	66	34½
7	32	36	33	56	69	72	33
8	32	33	32	53	66	69	
9	32	46	34	57	64	66	32
10	33	48	37	57	67	66	
11	32	48	38	57	66	68	31
12	34	52	40	56	69	66	
13	32	56	36	56	65	65	

Average temperature during the 31 days—

Out of doors,

Morning	19.9
Midday	32.8
Evening	25.5

In the room,

Morning	51.
Midday	65.8
Evening	66.1

Average quantity of coal consumed per day, 21.42 lbs.

Average coal consumed per day during the last nine days, when the external thermometer was nearly at the freezing point every morning, 14.4 lbs.

Average consumption the first 22 days, when the thermometer was constantly below freezing, 24.2 lbs. per diem.

It thus appears that estimating the stove to be in action during five months, or 150 days, commencing with the first of November, and ending with the last of April, the quantity of coal required, when the external thermometer averaged 20° of Farenheit, would be 3213 lbs., or less than a ton and a half; that if the range of the thermometer during the winter should average 32° (the freezing point) the quantity required would be less than a ton;—that the weather must be severely cold to

require a rate of combustion exceeding a ton and a half;—and that this quantity would be sufficient to maintain the temperature of a room 18 feet square, at 60° during the night, and at 66° during the day.

But there are two other advantages in the construction which Professor Olmsted has adopted. *First*, By increasing the extent of heated surface, so as to prevent the iron from ever becoming so hot as to lose its polish by oxidation, and thereby not only to become, itself, rapidly deteriorated, but also greatly to injure the quality of the air. *Second*, The cold air which enters the room, and necessarily forms the lower stratum, flows towards the stove, and ascending in the open and heated cylinder of the radiator, forms a rising column of warm air, which, by its diffusion, produces a mild, summer heat throughout the chamber, rendering unnecessary the evaporation of water to counteract the usual deleterious effects of a hot stove. I found, on one occasion, the temperature of the air in this heated column to be 150°, while at the same time the thermometer, with its bulb resting on the last joint of the stove pipe, sunk to 110°, the thermometer in the room being then 70°, and outside of the house 36°. Both the furnace and the radiator may be too hot to be endured by the hand, while the end of the pipe remains barely warm.

It was no part of the design of this trial to furnish a laboured eulogium of the particular kind of stove in question. There may be other forms which would produce similar results. I can only say that I know of none. But in the use of any close stove for burning anthracite, care must be taken, by a due regulation of the draught, to prevent the escape into the room of the gases which arise from combustion. The truth is, that, heat a room as we may, and especially a bed room, the air must be gradually and constantly renovated to prevent deterioration, and to preserve it in a state perfectly fit for free and healthful respiration. Hence the great importance of good ventilation. This, in the case above described, was effected by leaving open, as occasion required, a hole made for a stove pipe near the ceiling, and opening into an adjoining flue of the chimney. By these precautions I slept constantly in the room during the experiment, with the door shut, without any inconvenience, except having to rise once or twice to open the ventilator, when it had been left closed on going to bed. Such an opening into a chimney can be easily regulated by a sliding valve, and ought (unless there be some equivalent) to form an appendage to every close sleeping room.

Progress of Physical Science.

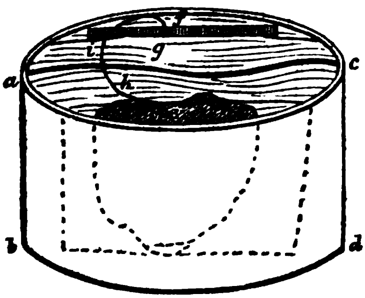
Origin of Mineral Veins.

Extract of a letter from Robert Were Fox, Esq. to J. Griscom.

Falmouth, 11 mo. 30th, 1837.

"My theoretical views relative to the origin of mineral veins, have derived strong confirmation from some of my subsequent experiments, one of which I will refer to, because it bears on the symmetrical structure of sedimentary rocks. On exposing clay which had been pulverised, and afterwards moistened with acidulated water and worked up into a plastic state, to long continued voltaic action, it assumed the *laminated* appearance of clay slate.

Let *a, b, c, d,* represent an earthenware vessel, *e* copper pyrites, and *f*, a plate of zinc, connected by a copper wire *e*, and separated by a wall of clay, *a, c, g, h,* the copper and zinc cells having been filled with acidulated water. An apparatus thus prepared was set aside for some months, till the clay had become dry, and on its being taken out of the vessel, it separated into portions as indicated by the parting line *a, c,* each portion having *laminæ* in the same direction, shown by the finer lines, so as to give the whole mass a schistose appearance. A second experiment indicated precisely the same phenomena.



It is evident that the divided portions of clay *g* and *h*, were, like the metallic bodies, in opposite states of electricity, and one of them, consequently, in a more favourable state than the other, for the deposition of metals &c. from their solutions. This is precisely the reason which I have ventured to assign for metals being found in some rocks, in preference to others, and this often depending more on the *positions* of the rocks, or strata, with respect to each other, than on their natures merely; the numerous lamina in the clay also show that a series of pores may be formed in earthy matter, and serve to explain why insulated portions of metals, copper and the oxide of that metal, for instance, occur in masses of clay which have been long submitted to voltaic action after they have been moistened with a solution of the sulphate of copper.

The experiments I have referred to, seem to bear directly on the cause of the lamination and structure of rocks, and we may perhaps be enabled to infer from their lamina, the direction in which the electricity has principally acted upon them, its influence having apparently been greater on the more heterogeneous sedimentary rocks, than on the more homogeneous ones, in which molecular attraction seems to have predominated.

I send a polytechnic report for 1834, containing a description of my dipping needle, although some improvements have been made since this account was published.

This instrument has been used by Lieut. Burnett, at sea, on his voyage with Sir John Franklin, to Van Dieman's Land; the results thus obtained, are highly interesting, and he has sent a very satisfactory report of its performance.

I have also received most favorable and unqualified reports, of a similar instrument sent on Capt. Back's expedition towards the N. W passage; and of another which accompanied Colonel Chesney on the Euphrates.

I mention these facts as they may induce one of your Institutions to have one of these instruments.

They are made by Thos. Jordan of this town, who has supplied the admiralty and ordnance Boards with them for observations at sea, and on land, and I believe that no one in England makes them so well, or at so cheap a rate, his price is from £14 14*s* to £30, according to circumstances; the lower priced ones are not calculated for observations on the magnetic variations, but will answer perfectly for the dip and intensity."

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Notice of three specimens of Garnet. By Thomas Elder, Jr.

1st. *Melanite.*—The chief localities of the black garnet, or melanite, hitherto known, have been Vesuvius, where it is imbedded in lava, and near Rome. Specimens of the same have lately been found on the Round Top mountain, about a quarter of a mile N. E. of Hummelstown, Dauphin county, Pa., in a trappean rock belonging to the range of the Conewago hills. The crystals are very distinct, presenting the usual dodecahedral form of garnet, with their edges sometimes replaced by a plane, and are therefore a combination of the dodecahedron with the icosatetrahedron. They are generally of a rich velvet black colour, opake, and with a resplendent lustre; a few, however, are greenish brown and translucent on the edges. The irregularities of their cleavage distinguish them from other varieties of garnet.

2d. *Cinnamon Stone.*—This beautiful mineral from Ceylon, has long been known and classed with the garnet from its chemical composition, its crystalline form having never been observed. I lately saw a specimen obtained from Mr. Nuttall, found on the line between New Jersey and New York, which is well worthy of particular notice, in consequence of its form. The crystals are remarkably distinct, with the brilliant surfaces and sharp edges of the dodecahedron, which in most cases are replaced by planes, and in a few instances the edges of this new plane are replaced by minute faces. They present, therefore, a combination of the dodecahedron and icosatetrahedron, with small planes of the hexaicositetrahedron. The lustre is more brilliant than that of the precious garnet, and the colour much lighter than the cinnamon stone from Ceylon, while the well formed crystals are nearly transparent. Experiments by the blowpipe prove that the quantity of iron present is smaller than is found in any other variety of garnet, excepting the Grossular.

3d. *Colophonite.*—This mineral is generally found in the form of irregular coarse grains, aggregated together; but I lately saw a specimen distinctly crystalized and presenting an unusual combination. It has the form of trapezoidal garnet, (icositetrahedron,) but where the faces of the dodecahedron should appear, may be observed a low four sided pyramid, which would make a solid of $12 \times 4 = 48$ planes. It is therefore a combination of the icositetrahedron with the hexaicositetrahedron, and without a single plane of the dodecahedron,—a combination of very rare occurrence, excepting in the diamond.

Philadelphia, January 27, 1838.

Melanites rivaling in beauty those of Frascati, have been found at Franklin, New Jersey. They have also been found at Germantown. An analysis of the Franklin Melanite was made by Henry Seybert, and published in Silliman's Journal, Vol. VIII, p. 300. G.

Franklin Institute.

Committee on Science and the Arts.

At a stated meeting of the committee on Science and the Arts, held April 15th, 1837, a circular letter from the Hon. Levi Woodbury, Secretary

of the Treasury, was received, proposing inquiries on the subject of a system of Telegraphs for the United States, and

At a special meeting held on the 18th of the same month, the following report was read and adopted.

Report on Telegraphs for the United States.

The committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic arts, to whom was referred the communication of the Secretary of the Treasury on the subject of telegraphs, think it would be premature, if not impracticable, to enter, at present, into minute details as to the matter referred to them, and judge that the Institute would fulfil the wishes of the Secretary more effectually by making to him an early communication of their general views, and leaving to a future correspondence any further developments that may be required of them. It is under this impression that the committee have hastened to prepare the following report:

1. *Kind of Telegraphs.*—The ample details given in Rees's Cyclopedia and other works as to the different schemes employed or proposed for telegraphs, render a description by the committee unnecessary. Only one of these telegraphs seems to have stood the test of long experience: it is that invented by Chappe, and employed in France since the year 1793. It is composed of three arms: one about eight feet long, movable around its middle point; and two of half the length, attached by their ends to the ends of the first, and also movable; the movements being communicated, from within the building, by cords and pullies. This telegraph is capable of giving one hundred distinct signals. It is believed, however, to be unnecessarily complicated, and has the disadvantage of not being suited for night signals.

The committee are, therefore, disposed to recommend a much more simple instrument, nearly similar to one lately introduced by M. Chateau, in a line of telegraphs which the Russian Government is erecting between Petersburg and Warsaw, and which is described in a late number of the Petersburg Transactions, by M. Parrot, together with a scheme of his own, almost identical with it, on which he had made successful experiments many years before.

This proposed telegraph consists of a single arm, or *indicator*, which should be about nine feet long and one foot wide, with a cross-piece at one end, about three feet long and one wide; the whole arm being movable about an axis at its centre. The arms are formed like Venetian shutters, and are painted a dead black: the apparatus and fixtures about it being white.

The movements may be communicated with ease and certainty, either by an endless chain passing over a wheel on the axis, and a wheel in the building; or by bevil wheels on the axis, and on a vertical bar passing from the building; or by a cog-wheel on the axis, and an endless screw on a vertical bar.

For night signals, three lamps are used: one swinging beyond the end of the arm; the other two beyond the ends of the cross-pieces.

2. *The Signals.*—The signals are given by the different positions of the arm of the telegraph. M. Chateau used only eight, but M. Parrot, by experiments in which the Emperor Alexander was an observer, de-

monstrated that twelve positions, distant 30° apart, could be readily distinguished. By an appendage (which will be proposed) to the telescope, all doubt on this subject will be removed.

Now it is believed that twelve fixed signals, together with those which may be given by certain motions of the arm, are abundantly sufficient for all telegraphic communications, whether alphabetical or numerical.

For this purpose, let the twelve different positions represent the following numbers and letters:

1	2	3	4	5	6	7	8	9	10	11	12
a	*b*	*c*	*d*	*e*	*f*	*g*	*i*	*l*	*m*	*o*	*s*
	p	*k*	*t*		*v*	*j*	*y*	*r*	*n*	*u*	*x*
	ph	*q*	*th*		*w*						*z*
		ch			*wh*						*sh*

The *h*, being only an aspirate, is omitted.

To indicate the separation of words, the arm may be vibrated twice, namely, one space (30°) to the right, and one to the left of the signal, and then carried to the first letter of the following word. To repeat a letter, the arm may be turned a space to the right, and then immediately brought back to the first position. To indicate that signals of numbers are to be given, the arm may be turned to the right, entirely round, and as much farther as may be necessary to carry it to the position 10, which is the 0 of numerical signals. To separate numbers, the same sign may be used as for separating words. To indicate that the signals of numbers are completed, the arm may be made to revolve entirely round to the left. When a wrong signal is given, the fact may be indicated by moving the arm backward and forward once, a distance of 90°, &c.

Suppose, now, the following signals to be seen and noted down.

4, 5—5, 10, 10, 5, 10, 8—1, 12—9, 1, 10, 4, 5, 4—1, 4—2, 1, 9, 4, 8, 10, 11, 9, 5—6, 8, 4—ↄ17,000c—10, 5, 10.

Taking the upper letters of the key, the despatch would be as follows:

De emmemi as lamded ad Baldimole, fid 17,000 mem;

Of which the true reading may be seen, even without the further aid of the key, to be this:

The enemy has landed at Baltimore with 17,000 men.

To prevent the discovery of the key, it may, when secrecy is important, be changed from time to time, without difficulty or inconvenience, since it is only at the extreme stations that it need be known.

If the system of signals, by a telegraphic vocabulary, be found most desirable, it will only be necessary to use the telegraph to indicate the numbers corresponding to the words in the vocabulary. In this way, if the ordinary decimal notation be employed, 999 words may be indicated without any one requiring more than three signals, 9,999 without more than four. But if the duodecimal notation be used, 1,463 words may be indicated without exceeding three signals for each, and 16,104 without exceeding four.

3. *The telescopes.*—For the telescopes to be used, M. Parrot recommends an achromatic object-glass of 3 inches diameter and 3 feet focal distance, and a double concave eye-glass of an inch and a half foca

distance. This is, in fact, a Galilean telescope, of the simplest construction, and will have a magnifying power of 30. The inconvenience of a very small field of view is of no consequence in this case; and the property of giving an erect image, with but two glasses, is perhaps of some importance.

Still the committee are disposed to give the preference to the common astronomical telescope, which has only the inconvenience (if it be one) of inverting the image, and which allows the use of an appendage deemed to be of some importance. This is a set of cross-hairs placed at the focus of the eye-glass, to correspond with the twelve positions of the arm of the telegraph, and thus pointing them out without the possibility of mistake. The true numbers, corresponding to the positions as seen in the telescope, may be marked on a diagram placed before the observer; so that, in calling them out, he will not be exposed to any mistake in consequence of the inversion of the image by the telescope, or by the back and front view of the telegraph.

The telescope, being fixed in its position, will be, of course, without the ordinary arrangements for motion. It should be placed entirely within the building; its object end being inserted into a hollow cylinder of wood passing through the wall, and painted black on the inside, so that all stray light may be kept from entering into the telescopes, and distracting the view of the observer.

It is scarcely necessary to add that there must be two telescopes at each station.

4. *Distance of telegraphs.*—The mean distance of the French telegraphs is two leagues, or six miles. In the experiments made by Parrot, and in which the image was very distinct, the distance was ten wersts, or about 7½ miles. The distance must be, in some measure, determined by the suitableness of the stations in other respects; but the maximum should not probably exceed 7½ miles, or the mean, six.

In selecting the stations, care must be taken that there be no considerable deviation from the front view of the telegraph on either side; and that it may be seen, from the adjacent stations, projecting against the sky.

5.—*The time of signals.*—In the French telegraph, the time required for each signal is estimated at 20 seconds; but it is believed that the simple signals of the proposed telegraph can be made and repeated much more rapidly; each signal in the former requiring three movements, in the latter only one. Far greater attention, morever, is necessary in the French telegraph, to see what is the true signal made; and this also requires time.

M. Parrot, from his experiments, estimates that it will require three seconds to see with certainty, and to dictate a signal made; three seconds to repeat it; and three to remain till it be repeated at the next station: in all, nine seconds—say ten—for each signal.

A line of telegraphs from New York to Washington would require about 40 stations; hence a signal made at New York would be repeated at Washington at the end of 400 seconds, or 6⅔ minutes. A despatch of 100 signals would require 1,000 seconds, or 16⅔ minutes at the first telegraph, and would be communicated to the last at the end of 1,400 seconds, or 23 ⅓ minutes.

6. *Telegraph buildings.*—On the line of telegraphs the buildings may be of wood, about 22 feet square, two stories high, and with a roof in the form of a quadrangular pyramid, surmounted by a small platform. In such a building it is judged that the arrangements for the telegraph, and for the necessary accommodation of the operators, may be made. In the cities, the telegraph must be placed on the top of some suitable building of considerable height.

7. *Men and officers.*—In urgent cases, three persons ought to be employed at each telegraph while it is in operation; one at each telescope, and one to make the signals. The observers may easily record the signals as they see them—if, indeed, this be necessary. In ordinary cases, two operators, or even one, will be sufficient; but as a lookout should be kept constantly, both day and night, less than three persons ought not to be employed at each station.

At each *principal* station there should be a secretary. Every ten stations should have a superintendent; and, if the system be considerably extended, there should be a director-general to take charge of the whole business, with book keepers and clerks to assist him.

8. *Estimate of cost.*—Although the committee cannot pretend to accuracy in their estimates of the cost of establishing and maintaining a line of telegraphs, they have thought that even an imperfect approximation might be deemed of some interest and importance, and they have accordingly prepared the following:

At each station on the line.

Cost of ground for the building and enclosures	$ 100	
" building	1,000	
" necessary furniture	200	
" well and pump	100	
		$ 1,400
Cost of telegraph and fixtures	$ 300	
" two telescopes	100	
" clock	20	
" transportation and putting up	80	
		500
contingencies		100
Total *first cost*		$ 2,000

Annual expenses of each station on the line.

Salaries of the operators, which may be a man and his family	1,000	
Fuel	50	
Oil	50	
Contingencies and repairs	200	
		$ 1,300

Annual expenses for officers, &c.

Salary of Director-General - - -		2,500
each Superintendent - -	1,000	
Horse and traveling expenses, extra	300	
		1,300
Secretary at principal station		1,000
		$ 4,800

Estimate for a line from New York to Washington.

36 telegraphs, at $2,000 each - -	72,000	
4 city telegraphs, at $5,000	20,000	
		92,000
Contingencies, and general superintendence of erections - - - - -		8,000
Total prime cost - -	$	100,000

Annual charge of 40 telegraphs, at $1,300 each - -	52,000
Five superintendents, viz: two between New York and Philadelphia: two between Philadelphia and Baltimore; one between Baltimore and Washington - - - - - - -	6,500
Four Secretaries at the four cities - - - -	4,000
Total annual cost -	$ 62,500

9. *Selection of lines of Telegraph.*—The lines of most obvious necessity are those from the bays, along the rivers, to the great cities. As a general line, one from New York to Washington would be of great interest and importance. If found successful, lines might be afterwards extended to other great points.

For the location of the stations, it would seem particularly suitable to employ the services of the corps of topographical engineers.

10. *Experimental telegraphs.*—In conclusion, the committee would respectfully suggest to the Secretary of the Treasury to consider the propriety of causing two telegraphs to be erected, in which careful experiments may be made on all the points that bear upon the general question submitted to him by the House of Representatives; and the services of the committee, in erecting the telegraphs and conducting the experiments are hereby offered to him, should he think proper, and feel himself authorized to act upon this suggestion.

By order of the committee,

William Hamilton, *Actuary.*

Philadelphia, April 18th, 1837.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JULY, 1837.

With Remarks and Exemplifications by the Editor.

148. For a *Rotary Press for pressing Woolen and Cotton Goods;* Moses Bayley, Salisbury, Essex county, Massachusetts, July 5.

A cast iron steam box is to be made, the upper side of which is to be concave from end to end, so as to receive a cylinder, between which and the box the pressing is to be effected. The length of the box must be equal to the width of the cloth to be pressed. The cylinder, adapted to the concave, is made to fit it exactly by a covering of cloth; a roller to receive the cloth as it is pressed, by passing between the cylinder and concave, lies upon, and extends along said cylinder. When hot pressing is to be effected, steam is let into the steam box, the cylinder turned by proper gearing, and the cloth passed through, and rolled up, as indicated.

Claim.—"What I claim as my invention in the within described apparatus for pressing cloth, is the using of a metallic box so formed as that a pressing roller may be made to revolve within a concave extending along it, and into which box, steam or other heated material may be admitted when required; the whole constructed for the pressing of cloth, either hot or cold, substantially in the manner herein set forth."

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149. For a machine for *Thinning Cotton in the Rows whilst Growing;* John Weaver, city of Washington, July 5.

This machine is nearly identical with one for the same purpose, patented by Jordan Gatling, on the nineteenthof June, 1835, and noticed at page 50, Vol. XVII. The slight difference consists in a revolving harrow, which it is not necessary to describe particularly, and to which the claim is limited.

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150. For a *Pistol Knife, or Cutlas;* George Elgin, New York, July 5.

The blade of the knife, or cutlas, extends back on the lower side of the pistol barrel, to which it is firmly attached, and it extends forward of the barrel, to any required distance, its back still being in a line with the lower side of the barrel, so as to be entirely out of the way when the pistol is fired. The claim is to the combining of the pistol and blade in the manner described.

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151. For an improvement on the *Axle and Thorough Box for Carriages* of various descriptions; William Slicer, Baltimore, July 5.

The particular arrangement of the respective parts of the box and axle would require a drawing for their explanation. The claims are to "the extension or projection of the box back of the hub, by which I use an axle with an arm and box of extra length. The outer form of the box, being constructed with a large flanch, or collar, against which the hub is firmly fixed by a nut on the small or outer end of the box, and against the outer end of the hub. The method of fastening the box in the hub by a nut, coupling, or other fastening, on the outer or small end of the box. Using the outer end of the box, by stopping it with a

screw or otherwise for the point of bearing, to prevent the wheel from running too far back on the axletree. The use of this or any other form of axletree, without collar, washer, shoulder, or other bearing, except the point of the axle. The use of this conical or pointed axle without a nut or linch-pin, or other fastening on its outer end.

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152. For an improvment in the *System of Cutting Garments;* Andrew Wiswell, Exeter, Rockingham county, New Hampshire, July 11.

The illustrations of this system extend through six sheets of drawings, which, as we have not taken the trouble to understand, we cannot explain.

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153. For a *Tobacco Press;* James T. Bowman, Pattonsburg, Botetourt county, Virginia, July 5.

The follower of this press is brought down by a screw in the usual manner, and the pressing is effected in a number of cells, or separate compartments, divided from each other by sliding partitions. The pound, or other rolls, to be pressed, are put into the cells, each with a separate block upon which the follower is to act. There is a contrivance for elevating the tobacco in the cells, and the sliding partitions, simultaneously, by means of a lever beneath them. The claim is to the "press for pressing tobacco, made and operating substantially in the manner of that herein described; that is to say, having sliding partitions which can be raised so as to form separate cells for the reception of tobacco, and withdrawn for its removal after it has been pressed."

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154. For a machine for *Spreading Lime, Ashes, and other kinds of Manure;* Francis H. Smith, Baltimore, July 5.

The material to be spread is put into a cart, the bottom part of which, about a foot in the rear of the axle, is formed into a hopper, within which two rollers, reaching from side to side, revolve by means of cog-gearing moved by a driving cog wheel upon one of the hubs. The rollers are to be of iron, and one of them is to be fluted, or armed with protuberances projecting out about three-fourths of an inch; the other may be smooth: one of the rollers is borne up by a spring, which is very strong, but will give way should a stone too hard to be crushed pass between the rollers. The claim is to the combination of the two revolving cylinders, with the spring to admit of their receding. The application of the cog gearing as described, and the mode of regulating the velocity by different pairs of wheels fitting on the same centres.

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155. For improvements in the *Plough;* Samuel Hartpence and John D. Bowne, Kingwood, Hunterdon county, New Jersey, July 5.

We have repeatedly remarked that after the numerous patents for ploughs, amounting, in this country only, to upwards of two hundred, individual improvement of a striking character ought not to be looked for; but still, those acquainted with the progress of improvement in this instrument are well aware that our ploughs are better in many respects than they were ten years ago.

The claim is all that we shall offer in relationship to the plough mentioned at the head of this article; and, indeed, is as much as is usually necessary. It is to "the manner of constructing the cutter with a screw

bolt above, passing through the beam; and a holdfast, or clip, below, passing through the piece forming the share and point, made in the manner set forth, and holding the whole together substantially as described. Also the placing of a roller upon the rounded part above the cutter, for the purpose of preventing the clogging of the plough."

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156. For a *Plough;* John C. Smith, Kingwood, Hunterdon county, New Jersey, July 11.

The claim in this plough is to the "making the share of a rhomboidal figure, beveled and brought to a cutting edge on two of its ends, so that when one edge wears away it can be reversed, or turned end for end, being secured to the sheath by two screws near the centre."

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157. For a *Machine for Hatcheling Hemp, &c.;* Phineas G. and Gabriel Rice, Danville, Mercer county, Kentucky, July 11.

A large cylinder set with teeth has four, or any other convenient number, of slats, supported above its upper side, and set with teeth pointing towards the cylinder. A doffing cylinder, set with card teeth, removes the tow from the main cylinder, and it is carried off from the doffer between suitable rollers. The hemp to be hatcheled is fed by hand on a board whence it passes between feed rollers, and is hatcheled between the toothed cylinder and slats; the unhatcheled end being held in the hand. When it has been operated upon sufficiently, the motion of the feed rollers is reversed by the aid of a lever which acts upon a band and pullies in a way to produce this effect; the hatcheled part is thus withdrawn, the motion again reversed, and the other end of the hemp passed in.

It will be perceived that this machine offers but little novelty, and the claim is, therefore, very limited, embracing only "the reversing motion given to the feeding rollers, for the purpose set forth, in combination with a machine for hatcheling, the parts of which are constructed, arranged, and combined substantially in the manner described."

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158. For a *Combination Spring and Bolt Sash Fastening;* Philip F. Hazard, Philadelphia, July 11.

The sash fastening described in the specification of this patent resembles very closely such as have been heretofore employed, the main novelty consisting in the employment of a spring sash fastening on one side of the frame, and a permanent bolt on the other; the former of which serves to retain the sash at any height to which it may be raised, and the latter to secure it in its place when it is down. Several modifications of the plan proposed are mentioned, which it would not be interesting to detail. The claim is confined to the combination of the spring and permanent bolts.

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159. For an *Apparatus for Colouring Maps;* Lucius Stebbins, Hartford, Hartford county, Connecticut, July 11.

The claim is "to the printing the colours upon maps by means of separate stamps, the surfaces of which are covered with some yielding and absorbent material, and which are cut into the form of the various

divisions to be coloured, and are supplied with colouring matter, and forced against the map, in the manner set forth."

A table is made, the top of which should be of metal, and as large as the map to be coloured. This is divided by partitions raised from it, into cells, or troughs, corresponding with the outlines of the divisions on the map. Each of these troughs contains the proper colouring matter, and a plate fitting it, and covered with cloth to absorb the colour. These plates can be raised simultaneously by a press acting upon stems descending from their under sides, the map being placed above and sustained by suitable means. The plan is intended in particular for school atlases.

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160. For improvements in the *Apparatus, or Machinery, employed in the Manufacture of White Lead, or Carbonate of Lead;* Charles Ripley, Saugerties, Ulster county, New York, July 11.

The patentee states that "the general principle upon which he proceeds to produce white lead, or carbonate of lead, is by exposing blue, or metallic, lead, in suitable apartments, or chambers, to the action of the vapour of vinegar, or acetic acid, to carbonic acid, and to oxygen gas, at such a temperature produced by steam, as shall best promote the chemical reaction of these agents, so as to produce the substance in question."

The claims made refer to the particular arrangement of the gas and steam pipes, and the mode of governing the supply of the requisite agents in the corroding chambers; all which is fully exemplified by references to drawings.

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161. For improvements in the *Machine for moulding Candles;* Joseph H. Tuck, Nantucket, Massachusetts, July 11.

"By the use of this machine it is intended to mould a number of candles upon continuous wicks, the moulded candles being drawn from the moulds by suitable apparatus, a fresh supply of wick being at the same time drawn into the moulds, and so on in succession, until seven, eight, or any other convenient number, are moulded upon each wick, which number will be governed by the height of the machine, after which the candles are to be separated from each other." The particular arrangement of the respective parts of this machine is fully explained and represented. The patentee says, "I do not claim to be the inventor of stands of moulds, nor of several other of the individual parts of the machine described; nor do I claim the invention of simultaneously drawing the moulded candles from their moulds by means of a rising frame, this having been previously done, but in a manner differing essentially from that which I have adopted. But what I do claim is the successive moulding of a number of candles upon the same wick without the necessity of separating them from each other until a number have been moulded, in the manner herein described. I also claim the whole arrangement of what I have denominated the sliding shutters, the wick directors, and their appendages, operated upon by sliding frames substantially in the way and for the purpose set forth."

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162. For a *Serving and Worming Mallet;* John B, Petival, civil engineer, Charleston, South Carolina, July 11.

There have been two or three patents for apparatus for serving and worming ropes for marine purposes, in which the yarn to be employed is wound upon a reel, or bobbin, separate from the worming mallet. That which forms the subject of the present patent consists of a mallet, the head of which is hollow, and contains the bobbin upon which the yarn is to be wound. A groove is made along the mallet, in the usual way, to receive the rope which is to be served, or wormed.

"What I claim as constituting my invention, is the making the head of a worming, or serving, mallet, hollow, so as to receive and contain the bobbin, or bobbins, upon which the yarns are wound which are to be employed in the process of worming, or serving." It is proposed by the patentee to make the head of the mallet of metal, which will leave more room in the interior, and it may be made lighter than those of wood.

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163. For an improvement in the *Mode of Hanging or Suspending a Band Wheel* in those horse powers in which the band is conducted under the feet of the horse; Isaac Straub, Lewistown, Mifflin county, Pennsylvania, July 11.

The claim is to the sustaining the band wheel, which is horizontal, by means of necks and collars, placed above the wheel, without any step, or bearing, below it. The collars are, of course, attached to the frame work of the machine. This manner of fixing such wheels, for aught that appears, is new, but we do not see the particular advantage to be derived from so hanging them and are apprehensive that friction will not be diminished, or permanence promoted, by this device.

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164. For improvements in the machine for *making rivets for steam boilers;* and for other purposes; Levi Severance, Pittsburg, Allegheny county, Pennsylvania, July 11.

The arrangement of the gripping, cutting off, and heading, parts of this machine differs from those which have preceded it, and are well contrived. The claims are limited to this particular manner of constructing these parts. We have specimens of rivets, both of iron and of copper made by this machine, and they are perfectly well formed. The most careful among the boiler makers, however, object to the machine-made rivets for iron boilers, on the ground that the iron ought to be of a welding heat for each individual rivet, when made; it being, otherwise, liable to split in riveting, and is brittle when finished.

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165. For an improvement in the method, or art, of *Carbonating and Smelting Iron Ore;* Asa Whitney, Smithfield, Orange county, New York, July 17.

"I build within the stack of a blast furnace, a cementing chest, or tube, which I can close at the top, and which has an aperture in the bottom through which the prepared ore descends as it melts, into the crucible of the furnace. I surround the said cementing tube, or chest, by spiral flues through which I cause the heat of the furnace to pass." The particular manner of constructing the cementing tube, the flues, and other appendages, is well represented in the drawings accompanying the patent.

"Having good fires in the tubes for heating the air, and the cementing chest nearly full of charcoal, or coke, which is burning out, or slowly

passing down the aperture at the bottom, into the centre, or confluence of the three currents of heated air, in the crucible, I begin to charge the cementing tube with such proportions of ore and fluxes as may be proper for smelting and promoting good separation of the metal from the scoria, with just as much carbon as may be necessary for carbonating the same, and as it settles down I continue to supply more at the top through the feed box, which I close immediately after each charge, until the cementing chest is full, or, to speak more correctly, until the ore and fluxes have descended to the aperture, at which place I expect the ore to be perfectly carbonated, and that it will smelt easily as it passes into the crucible, with good separation of the metal from the scoria; and thus continue working with regular seriatim charges."

"The advantages to be derived from using the before-described furnace are particularly prominent in situations where charcoal is scarce, and other fuel, such as anthracite coal, &c., is abundant; or where ores are abundant and the quantity of charcoal is limited in proportion to the supply of ore."

"What I claim as my invention and discovery, and not before known, is, the building of a cementing oven, or chamber, within the stack of the furnace, and thereby carbonating the ore free from the influence of oxygen, as much as possible; also the form of the crucible, and the application of heat for carbonating and smelting the ore by making the current of air pass in a spiral manner round the cementing chamber up to the smoke chimney."

We have thus given several extracts from the specification of this patent, which are calculated to afford a good general idea of the nature of the thing proposed to be done and of the means by which it was to be accomplished. It will be recollected that the separate carbonating of the ore was proposed in a patent obtained some two years since, by Mr. Boyden, whose plan made much noise for a time, but soon passed from public notice, in consequence of its utter failure. Without pretending to the skill of the practical iron master, we had anticipated such a result from examining Mr. Boyden's specification, as it was apparent, upon the face of it, that the scheme was an untried one, and the means proposed, if carried out, would have been attended with great expense. We believe also, that Mr. Whitney's project has not been carried into operation; he, however, has the reputation of great skill and experience, and we know that it was his determination to test his plan fully; this, we doubt not, would have been done long since but for that state of paralysis which has arrested the voluntary motion, and nearly destroyed the vitality, of all manufacturing and commercial establishments and enterprises.

Without intending to impugn the idea that iron may be carbonated in the smelting furnace, by means analogous to those described, we much doubt the possibility of performing this process upon the unsmelted ore; believing that it is with the reduced iron, and not with the ore, that the carbon combines; and that the ore will be prepared for this combination, in the cementing chamber, only by its being brought to that elevated temperature which will eventually effect its fusion, as it escapes into the crucible. Some may view this question as one of mere theory, but it is important that the true rationale should be understood, as this may lead most directly to a correct practice.

166. For an improvement in the mode of burning fuel in furnaces, by means of a *Suspension Grate;* Thomas Pearson, Monroe Works, Orange county, New York, July 17.

This suspension grate is intended for smelting, and other, furnaces, and is described as being used in Whitney's furnaces, which forms the subject of the last article. The general description of this grate, preceding the references to the drawings, as given in the specification, is as follows:

"I suspend each grate bar by one end, upon a pivot, or general suspension bar, and upon which every bar in the grate is also suspended. The grate bars are inclined, so that the fuel will easily slide, or pass down, them as the fire consumes away, as also will any scoria, or cinder, that may form during the combustion of the fuel. At the bottom of the grate is an inclined stone, dipping towards, and passing under, the bottom ends of the grate bars, down which the slag, or scoria, will flow into the ash-pit. Near the lower ends of the grate bars is a circular bearer which is turned into grooves for the grate bars to rest upon, and by which they are kept at a proper distance from each other. Upon this said circular bearer are as many wrought iron wipers placed firmly as there are spaces between the grate bars, and which arms, or wipers, by turning the bearer round, clear out any slag that may have accumulated at the bottom of the grate bars."

The claim is to the apparatus as above described.

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167. For machinery for elevating hay into barns, and upon stacks; George Welbur, Macedon, Wayne county, New York, July 17.

A frame is made which consists of horizontal sills resting upon the ground, supporting two vertical timbers, united by suitable cross-ties. This frame is to support an inclined plane which may be twenty eight feet long and six feet wide, with ledges on each side to keep the hay from falling off. There is a windlass attached to the frame, by means of which the elevation of the plane may be altered at pleasure. The hay is to be deposited upon a receiver, at the bottom of the plane, and drawn up by ropes passing around pullies at its upper end; as it is drawn up it is sustained by a rake below it, to which the above named ropes are attached. The claim is to "the combination of an inclined plane with an elevator upon which it is supported and by which its height is regulated, both possessing the characteristics and construction substantially as above set forth."

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168. For an improvement in the *Floating Dry Dock;* James Barron, Philadelphia, July 17.

This floating dry dock is to have its bottom and sides formed of logs from one to two feet square, laid in tiers lengthwise, and then crosswise, bolted together by wood bolts of from three to four inches in diameter, which, it is said, is double the size of those ordinarily used. The sides are to be double, with a considerable space between them, answering the double purpose of strength and buoyancy; this space being secured against the admission of water. There are gates at one end, as usual in such docks, to admit the vessel to be repaired, and there are the requisite appendages of blocks and shores to sustain the vessel when entered.

The mode of pumping out the water, or rather of discharging it, is a prominent feature of this apparatus. Within the dock there are two boxes which, ordinarily, rest with their bottoms upon the bottom of the floating dock, when one side of each rests also against one of the sloping sides of the dock. These boxes admit the water from the dock into them, through suitable valves, and they are capable of being raised and tilted by means of tackle attached to timbers above them. Towards their inner sides, these boxes are placed at some considerable distance apart, and as their sides recede from each other, being parallel to the outer sides, which slope outwards, they may be tilted towards each other, so as to stand nearly on their inner and lower angles, without interfering; these angles have gudgeons which constitute the joints upon which they tilt. Those gudgeons which are towards the fore part of the dock are hollow, and constitute tubes through which the water in the boxes is to be discharged, valves being fixed at their outer ends to prevent its return. In some cases a siphon is also to be used to aid in the discharge of the water.

The patentee states that by the means proposed, a dock for all merchant purposes can be pumped out by two men in one hour. We have made no calculation on this point, but upon the face of the thing, are apprehensive that this estimate is much too liberal; one thing is certain, that neither by this, or by any other method, can two, or any other number of men, raise more than a given weight of water to a given height in any designated period of time.

The claims are to "the construction and arrangement of the different parts of this dock; in the building it of logs; the method of pumping it out as above described, and also the economical means of connecting the whole mass together by wood bolts double the size of those which can be used in vessels of the ordinary construction." The latter part of this claim we view as altogether untenable, there not being any thing new in the use of pins, or treenails for holding logs together; and as to their size, if there be a dividing line below and above which they are and are not patentable, we should be glad to have it marked out.

A modification of the tilting box is proposed and claimed. This modification will be understood by supposing the two boxes to be united together by their inner sides, so as to constitute a single box divided into two compartments by a partition, with their lower sides uniting in an obtuse angle, which forms the bearing upon which the box may be made to rock from side to side.

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169. For improvements in the *Plough;* J. B. Norton, Philadelphia, July 17.

The claims made are to "the graduation," which is to a mode of fixing the clevis in any desired position, so as to cant the plough, and increase the width of the furrow, also to "the manner of strengthening and screwing the share to the mouldboard," which though believed to be new so far as the particular means adopted are concerned, does not offer any thing worthy of special notice: a projection formed on the landside for the handle to rest against, and the method of securing the mouldboard to the beam by means of a staple, are likewise claimed.

170. For a machine for *Reducing Thread Waste to the state of Cotton Wool;* Ogden Griswold, Hartford, Hartford county, Connecticut, July 17.

The claim is to "the construction and arrangement of the machine described, in which the waste threads are caught upon hooks, pins, or teeth, on a revolving reel or cylinder, and are whirled round and beaten against the edges of knives, or metal plates, so as to untwist them, and separate their fibres, in the manner set forth."

"The thread waste is placed upon a feeding apron, and is conducted by feeding rollers to a revolving reel, or cylinder, set with hooked teeth, along its projecting bars, or periphery, by which teeth the threads are caught and whirled round with great rapidity. The reel or cylinder is surrounded for more than half its circuit by plates of iron, which I denominate knives, against the edges of which the threads are beaten, causing them to separate into fibres. These knives extend from side to side of the frame of the machine, they are, lengthwise, parallel to the axis of the reel, or cylinder, and widthwise, form an angle of about forty degrees with its radii."

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171. For an improvement in the *Horse Power;* Levi Rice and Daniel Cogden, West Chester, Chester county, Pennsylvania, July 17.

This horse power is intended for two, or more, horses, to walk in different directions upon a horizontal floor. This floor is to be made of separate pieces of plank of sufficient length for the animal to walk upon. Suppose three horses to be employed, the floor is in this case to be so placed as to form a triangle, each side of which is long enough for a horse path; at each angle there must be a vertical shaft around which the floor is to revolve; a driving pulley is fixed upon each of these shafts, and is scolloped so as to fit into the inner, and curved ends of the planks which constitute the floor. The planks are connected together by joint straps on their flat sides, allowing them to open and close like the joint of a two foot rule, or rather like that of a card table hinge. The floor must be supported upon rollers. It will be seen by the foregoing description that there is much complexity in the affair; a complexity which, we apprehend, will soon condemn it to desuetude. The claim is to "the forming a horizontally revolving floor, with three or more centres, making it in the form of an oblong, triangular, or square figure, for two, three or more horses; and the right of shaping the ends and sides of the planks in any form so that the plurality of centres is preserved in the floor, for the purpose of propelling rail-road cars, thrashing machines, &c."

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171. For an improvement in the *Horse Power;* Levi Rice, Attleborough, Bucks county, Pennsylvania, July 17.

The claim is this horse power is simply to the manner of using plates and staples to connect the plank of which the endless floor is constituted, and to a variation in the manner of arranging the band of rollers upon which it is sustained; the whole affair is of no great importance, although possessed of some little novelty.

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173. For an improvement in the method of *Making Soap;* Daniel E. Stillwell, Utica, Oneida county, New York, July 17.

Hard is to be converted into soft soap, by dissolving about eight pounds of common hard soap in four quarts of soft water, heated over a fire, and then adding four ounces of sub-carbonate of soda; the mixture is then suffered to cool, and is ready to use as a convenient and active detergent. The patentee claims the foregoing combination as producing a material suited to become an article of commerce.

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174. For an improvement in the *Construction of Carriages*; Samuel C. Brown and Levi J. Hicks, Macedon, Wayne county, New York, July 17.

This patent is taken for an improvement in the construction of what is sometimes called the fifth wheel of a carriage, which consists of the apparatus upon which the axle of the fore wheels is sustained, and revolves horizontally, when the carriage is being turned. The claim is to "the use and application of cast iron in the construction of the fifth wheel; in combination with the convexity of the lower wheel; the flanch attached to said lower wheel; the flanch on the upper wheel, and the socket that receives the reach, or perch." These claims it will be seen, refer to certain peculiarities of construction which appear to possess sufficient novelty to justify the grant of a patent.

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175. For an improvement in the construction of the *Valves for Pumps;* Henry Heckman, Newburg, Cumberland county, Pennsylvania, July 17.

The whole claim to invention in this patent, consists in the forming of the valves for pumps of flat plates, covering the orifice in the seat, and keeping them in their places by two staples, crossing each other at right angles.

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176. For an improvement in the *Machine for pointing and cutting Wooden Pegs*, for pegging boots and shoes; Joseph Essex, Killingly, Windham county, Connecticut, July 17.

"By means of this machinery, the blocks, after they have been sawed and dressed to the proper thickness for the length of a peg, are first scored in two directions, so that the pegs when cut shall be sharp pointed, and afterwards split in two directions to complete them. The pointing is effected by means of revolving cutters which are fixed upon strips sustained like the rounds of a reel, by means of arms projecting from a revolving shaft." The particular apparatus for moving the block in the operation of pointing, and subsequently in that of splitting, cannot be described without allowing more space to it than the subject will warrant.

The patentee says he does "not claim the scoring, or the pointing of pegs by means of revolving cutters, but the manner of constructing and arranging the revolving cutting apparatus, having the cutters upon adjustable strips, in the manner set forth; also the double platform, the upper portion revolving on the lower, in the manner described."

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177. For an improvement in *Rotary Stoves*, by adding an oven thereto; Rensellaer D. Granger, Troy, New York, July 17.

The rotary stove upon which the proposed improvement is made, is that usually known as Stanley's. From the centre of the revolving top,

a pipe, furnished with a valve, rises vertically; a second pipe, also, rises vertically from the back part of the stove, clear of the rotary top, and leads, as does the first pipe, into the double case of an oven elevated above the ordinary height of the boilers which occupy the openings in the rotary top. By this arrangement a current of heated air may be directed between the double casing of the oven, whilst the other parts of the stove are continued in use. At the ends of this elevated oven, which may be round or square, there are doors, and within it suitable shelves to receive the articles to be baked.

The claims are to "the conveying the heated air from the fuel through two or more pipes into an oven elevated above the main body of a rotary stove, allowing the boilers to pass under it; and operating substantially upon the principle set forth." There is also proposed to be a swell, or curve, formed on the rotary top, to admit of a larger boiler than usual, when desired, the making of which is likewise claimed."

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178. For an improved *System of Tailoring;* Amos Sherman, Newark, Essex county, New Jersey, July 17.

The philosophy of the system of tailoring belongs to a class of Savans into whose school we have never been admitted; but we apprehend from the various reports of "Mathematical," "Standard," "Geometrical," and numerous other instruments for ascertaining the human contour and dimensions, that this department of science must be brought as nearly to perfection as are our terrestrial admeasurements by triangulation, or our knowledge of the longitude by the aid of chronometers, lunar observations, and the eclipses of the satellites of Jupiter. If we are mistaken in this conjecture, it belongs not to common minds to detect the error; and should a garment be now and then spoilt, this will no more prove that the philosophy of tailoring is not perfectly understood, than the use of a wrong exponent by the mathematician would prove that his science was incorrect.

In those departments of knowledge which are the most advanced, great discoveries are scarcely to be hoped for, but still every thing is progressive, and we should set a due value upon every step made towards absolute perfection, however short it may be, or however modest the terms in which it may be announced. After these preliminary remarks, we offer the following summary of the improvements now presented to us, which is in the following words: "The invention claimed by me, the said Amos Sherman, and which I desire to secure by Letters Patent, consists in the before-described method of taking measure, and cutting clothes; also the addition of the projection, or blade, to the square, and attaching the tape to the hook E, of the blades, as described."

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179. For an improvement in *White Paint;* Forrest Shepherd, New Haven, Connecticut. First issued March 18th, 1835; surrendered and reissued, July 17. (See Specification.)

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180. For an improved *Water Colour Paint;* Forrest Shepherd, New Haven, Connecticut, July 17th. (See Specification.)

181. For an improvement in the mode of *Applying Horse, or other Animal Power, to Propelling Machinery;* Barnabas Langdon, Troy, New York, July 19.

We have not here a perpetual motion, or any thing which actually sins against the laws of mechanics; still we are very apprehensive, that the patentee, who manifestly believes that he has devised an advantageous mode of communicating the motive power of animals to machinery, will eventually discover that he has been treading in a circuitous path, whilst he might, at less expense of time and labour, have gone directly up to his object by one of the more common and direct roads.

The horse, or horses, employed are to walk in a circle, and to draw by levers attached to a vertical shaft, in the manner well known. The machine as represented is for four horses, there being four arms or levers extending from the vertical shaft. Within the horse track there is to be a circular rail way, and upon this rest four wheels, each having for its axis one of the horizontal shafts above named. A circular platform, which may be equal in diameter to the circular railway, rests upon the tops of these wheels, and in order to produce the necessary adhesion, weights to any desired amount may be placed upon it. From this platform, motion may be communicated to machinery by affixing a cog-wheel on its upper side, with a pinion on a horizontal shaft working into it by bevil gear. This is the sum and substance of the machine, the description of which closes with the subjoined formidable claim.

"What I claim of the improvement thus above described, is the manner in which the circular flat rim, or platform, is made to revolve horizontally in its own circle by means of the progressive motion of three or more rollers, or wheels, rolling round a common centre upon a circular track, or railway, under the propulsion of horse, or other animal power, with the rim or platform placed on the top of the rollers and being supported and carried round by them; and the manner of accelerating its motion by means of longer wheels to be fixed by the side of such railway rollers upon the same shaft; and also the manner of communicating the power and effect of the momentum of the rim or platform, thus acquired, to other wheels, by the intervention of cogs, bands, or other means in common use, for the purpose of obtaining rotary movements for mechanical, manufacturing, or other practical purposes, as above described, together with the provision for adding weights as an overload for increasing the momentum, or friction, of, or between, any of the revolving bodies in connexion, as may be required; and also the principles embraced by the said improvements so far as the same are applicable to machines of the above description."

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182. For a sounding instrument for *Ascertaining the depth of Water in Seas, Rivers, &c.;* Francis B. Ogden, of New Jersey, and John Ericsson, of Sweeden, July 19.

This instrument is intended to ascertain with accuracy the depth of water, or soundings, from a ship or vessel, when, by reason of currents, the rapidity of the vessel's way through the water, or other causes, it cannot be determined in the usual manner by the lead-line." "The invention consists in ascertaining the depth by means of the pressure of the water, which at given depths is always nearly alike, the water being allowed to enter the instrument and made to compress a certain quantity of atmospheric air contained therein, and to overflow the orifice of a small

tube, into a glass tube, or recipient, in which it will rise in proportion to the superincumbent pressure, and thereby indicate the depth to which the instrument may be lowered." The claim made is to an instrument so constructed as to operate in the manner above indicated. The particular construction of such an instrument may admit of some variation, but the general principle upon which it operates will, we think, be sufficiently apparent.

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183. For an improved construction of *Grates and Fire Places;* Ellison Conger, Newark, New Jersey, July 22.

"The nature of my invention consists in supporting the coal upon a hearth, and making the flue at, or near, the bottom; thereby obtaining a horizontal draught of air through the fire, either direct or laterally." One of the figures in the drawing represents an open, or Franklin stove, with its hearth as usual, but having an opening for the flue just above the level of the back of the hearth; this flue leads into what is denominated a heat chamber, behind the fire, which, though it differs from heat chambers previously constructed sufficiently to give it some claim to novelty, it is not thought necessary to describe particularly. The other figures show the manner of conducting the horizontal draught through fires in grates in ordinary fire places. The claims made are to the particular manner of arranging the hearth and flue to obtain the horizontal draught; to the manner of making a sifter, and to the heat chamber as described.

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184. For an improved *Cooking Stove;* Abraham T. Mixsell, Belvidere, New Jersey, July 19.

The claim made is to "the construction and arrangement of the flues as described; and the apertures to admit or exclude the air at the sides of the stove, so that the fuel may be consumed under the hindermost boilers only, when this may be desired." To describe the peculiar arrangement of the flues and valves in stoves in all their varying combinations, would be no easy task, and there are few to whom it would be acceptable, if performed; in many cases the novelty would be small, and the utility questionable, and to be determined by the test of experiment only; and that frequently in one way by the purchaser, and in another by the inventor. There is more *novelty* in the form and arrangement of the valves and flues of the stove before us, than is usually found in these parts, but the reality of the *improvement* is not equally manifest.

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185. For an improved *Stove for Cooking and Heating;* William B. Kimball, Peterborough, New Hampshire, July 19.

In this stove there is a hearth at the lower part, with an opening, similar to that of the Franklin stove, in which wood may be burnt in the usual way; and above this there is an enclosed fire place, in which coal, or other fuel, may be employed, the grate bars standing immediately over the open fire place. There are flues and valves so arranged as to govern and direct the heat under cooking utensils, and around an oven situated at the back of the stove, which appear well calculated to answer the purpose intended. The claims made are to "the particular manner in which the double stoves are conbined with the flues or passages, valves, dampers, or shutters, with each other, as described; not

claiming either or any of these parts taken individually, or in the connexion of one individual part with another, but claiming that arrangement of the respective parts with each other, as a whole, so as to constitute a stove substantially the same with that set forth."

186. For improved *Self Adjusting Temples for Looms;* Samuel P. Mason, Newport, Rhode Island, July 22.

These temples are in their general construction very similar to others previously in use, the difference being in the arrangement of the parts by which the jaws are opened. The claim is to "the manner in which the stationary inclined plane and forceps are placed on the plate of iron; the manner in which the forceps are opened by being forced on said stationary inclined plane when assisted by the lathe, and are thrown off the inclined plane when the lathe recedes."

187. For an improvement in the manufacture of *Stoves for burning Anthracite;* Jordan L. Mott, city of New York, July 22.

This is intended to be an economical stove for the burning of, and cooking by means of, anthracite. It differs but little in form from such as have been before made from plates cast separately and put together in the usual manner. It is, in fact, a small open stove with a feeder for the supply of coal, and an opening for a kettle or other cooking utensil, and is intended for summer use. The claim is to "the casting the whole body of such a stove and its feeder, with the exception of the top and bottom, or in some cases conjoined with the bottom, in one entire piece."

188. For improvements in the mode of *Constructing Railroads;* Isaac Cooper, Johnstown, Cambria county, Pennsylvania, July 22. (See specification.)

189. For improvements in the mode of constructing and connecting together, the *Cars and Carriages used on Rail, and other Roads;* Robert Grant, Philadelphia, July 22.

"My first improvement consists in a mode of constructing the wheels and axles of cars or carriages, and their appendages, by which the draught is applied to a wheel which rolls within a rim upon a larger wheel near to its periphery, the tread of which larger wheel bears upon the rail or road. I am aware that this principle has been already applied, or has been proposed to be applied, to the wheels of cars and carriages, but by an arrangement differing essentially from that which I have adopted."

This plan of making a smaller wheel within the periphery of a larger drum, or wheel, has been made the subject of a patent in England, and was spoken of as a plan for enabling a car, or carriage, to carry its own railroad. The whole plan appears specious, but, hitherto, it has proved fallacious; and although the present patentee has manifested considerable ingenuity in the particular arrangements made by him, the structure is thereby somewhat more complicated, without the introduction of any thing apparently calculated to remove the objections to the general plan; we believe, indeed, that these objections are radical.

The second improvement proposed, is in the mode of constructing or

coupling trains of cars together by means of a double hinge joint. The claims are to "the manner of connecting the larger wheels by means of revolving tubes which constitute their axes, and allow the axle of the interior wheels to pass through and revolve within them in the manner described. Also the enclosing of the interior wheels by means of a face plate, and the combining therewith a central circular plate admitting the axles of the interior wheels to pass through them as set forth. Also the manner of combining the solid and tubular axles, either of the interior wheels, or of the ordinary wheels of railroad cars. Also the double, or greater number, of vertical hinge joints for connecting trains of cars together. Also the so placing of the middle rail of the frame of a car as that it shall aid in supporting it in case of the breaking of an axle, substantially as set forth."

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190. For improvements in the construction of a *Self Sharpening Plough;* Isaac Snider, Mount Pleasant, Westmoreland county, Pennsylvania, July 29.

The claims in this plough are to some small differences from the usual manner of attaching the parts of the plough together, not appearing to require any particular notice.

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191. For improvements in the *Machine for Planing Mouldings on Wood*; Ambrose Church, Jr., Canandaigua, New York, July 29.

This machine is for sticking mouldings by means of a moulding plane made to traverse back and forth, by a crank motion, in a manner frequently adopted. The claims are to certain particular devices and modes of arrangement, intended to produce accuracy in the result, and to facilitate the operation, in a way which cannot be shown without the drawings.

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192. For improvements in *Fire Arms;* Henry Harrington, Southbridge, Worcester county, Massachusetts, July 29.

The barrel of this gun is to consist of a great number of small tubes, which may be of a proper size for shot; it may be made by soldering these tubes within an ordinary barrel, extending its whole length. At the breech end of the barrel there is to be a mortice to receive a box or chamber, which is to be charged with the shot and powder. The end of this chamber which bears against the barrel is to be covered with a plate perforated with holes which coincide with those in the barrel; these holes are to be somewhat conical, the larger ends being towards the barrel. Shot are to be inserted in each of these holes, and pressed in by the finger; the chamber behind them is then to be filled with powder, and the box inserted in its place, when it may be discharged by means of a percussion cap. The same arrangement is proposed for cannon, and for pistols. The claim is to "the throwing of shot or balls from any number of barrels united together, by exploding powder in a single chamber, substantially in the manner above described." The patentee sets forth the advantages which he anticipates from a gun made in this way; we think, however, that were the disadvantages also to be enumerated, the positive terms would disappear, and there would remain a minus quantity.

193. For a *Process for purifying Salt Water preparatory to manufacturing Salt;* Nils Sholtewskii Van Schoultz, Saline, New York, July 29. (See specification.)

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194. For improvements in the machine for *Spinning Woolen Roving;* Edgar M. Titcomb, Andrews, Essex county, Massachusetts, July 29.

"The nature of this invention consists in passing the woolen roving between the opposite sides of an endless belt, while the sides of the belt are pressed into contact with the thread of the roving. While the thread passes between the opposite sides of the endless belt at right angles to those sides, the belt is in rapid motion over and under two rollers, and those opposite sides of the belt moving necessarily in opposite directions, and being in contact with the thread, twist the roving, and prevent its being broken as it is drawn out to greater length and fineness." The claim is to "the application of the endless belt, so as to twist the thread of the woolen roving on its passage from the back to the front rollers."

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195. For an improvement in the *Machinery for making Horse Shoes;* B. Young and S. Tistus, Brooklyn, Windham county, Connecticut, July 29.

"What we claim, therefore, is the manner of forming the shoe by the combined operation of the rollers, the guides, the conductor, and the die, arranged and constructed substantially in the manner herein set forth." The shoes, it will be seen, are to be formed, in part, by rollers, but the doing this is disclaimed as not being in itself new; the accessory parts, as represented in the drawings, manifest considerable skill, but whether they remove the difficulties heretofore experienced in making horse shoes by rollers, is a practical question, to be answered only by the machine itself, and we are not informed respecting what character it has established and sustained.

Specifications of American Patents.

Specification of a patent for an improvement in White Paint, for which letters patent were granted to Forrest Shepherd, *on the* 18*th day of March,* 1835. *Which letters patent were canceled, and reissued upon the following amended Specification, July* 17, 1837.

To all whom it may concern: Be it known, that I, Forrest Shepherd, formerly of Fredericksburg, in the county of Spottsylvania, and state of Virginia, but now of New Haven, in the county of New Haven, and State of Connecticut, have invented a new and useful preparation of white paint, to be used in combination with oil, in the same way in which white lead is now used; and I do hereby declare that the following is a full and exact description thereof.

I take the mineral known by the name of sulphate of barytes, barytes, or terra ponderosa, and reduce it to a fine powder, after which, I mix it intimately with oil, and, if necessary, again grind it, in the same way in which paint is usually ground.

With this paint as a basis, any of the pigments now used with other kinds of white paint, may be incorporated, and any desired tint, or shade of colour be thereby produced.

What I claim as my invention, or discovery, and wish to secure by letters patent, is the employment of the mineral, or native, sulphate of barytes, properly incorporated with oil, as a white paint, or as a basis with which various pigments may be used in the process of painting.

FORREST SHEPHERD.

Specification of a patent for an improved Water Colour Paint; Granted to FORREST SHEPHERD, *New Haven, Connecticut, July* 17, 1837.

To all whom it may concern: Be it known, that I, Forrest Shepherd, of New Haven, in the county of New Haven, and State of Connecticut, have invented, or discovered, a new manufacture of white water colour paint, using as the basis thereof the mineral known under the name of sulphate of barytes, by means of which a beautiful and perfectly opaque white is obtained; and I do hereby declare, that the following is a full and exact description thereof.

Instead of using oil with the barytes, as described by me in the specification attached to letters patent of the United States, dated the eighteenth day of March, in the year 1835, for "a composition to be used as a white paint;" I take the same mineral, sulphate of barytes, in its native state, and reduce it to an impalpable powder, and I then mix it with water in which there is a sufficient quantity of gum tracacanth, gum Arabic, or other adhesive gum miscible with water, or any other fluid not oleaginous, and adapted to give adhesiveness, or a binding quality, to the pulverized mineral. The composition may, if necessary, be again ground after mixture. This I lay on as water paint, and when properly prepared, it is of a clear white colour, and perfectly opaque. The paint thus prepared, adheres very firmly to wood, &c., and for various purposes will be found extremely useful, especially when it is not exposed to the vicissitudes of the weather; and in situations where it is so exposed, it may be rendered permanent by a coating of good clear oil, or spirit varnish. Various tints and shades of colour may also be given to it by a proper admixture of any suitable pigment, as in the case of the oil paint. This watei paint may also be very advantageously applied as a ground coat upon work which is afterwards to be covered by the oil paint.

I am aware that the artificial, or factitious, sulphate of barytes has been used as a water colour by miniature painters, and in other delicate works; but the application of the mineral, or natural, sulphate, as a water colour, is, as I believe, new, and of my invention, or discovery. What I now claim, therefore, and desire to secure by letters patent, is the employment of the natural, or mineral, sulphate of barytes, as a water colour, or paint, whatever aqueous fluid may be preferred as its vehicle, and whatever gummy or tenacious material, or pigment, may be mixed therewith.

FORREST SHEPHERD.

Specification of a patent for improvements in the mode of constructing railroads; granted to Isaac Cooper, Johnstown, Cambria county, Pennsylvania, July 22nd, 1837.

To all whom it it may concern, be it known, that I, Isaac Cooper, of Johnstown, in the county of Cambria, and State of Pennsylvania, have made certain new and useful improvements in the manner of constructing railroads, and I do hereby declare that the following is a full and exact description thereof.

My improvement consists, in part, in the form which I give to the upper sides of the string pieces upon which the rails, chairs, or plates, are to be sustained, or to the upper sides of the block of wood, or of stone, used for the same purpose; in the form and construction of the chairs adapted thereto, and in the manner of combining and connecting the respective parts together, so as to form a more stable foundation and superstructure than have hitherto been obtained at the same cost.

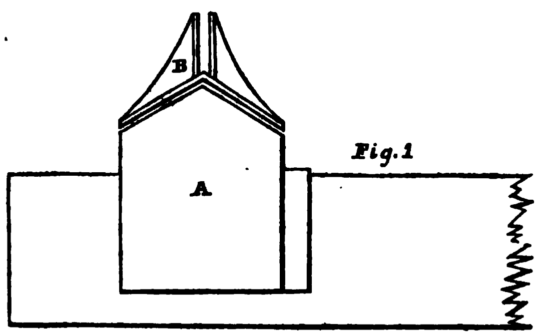
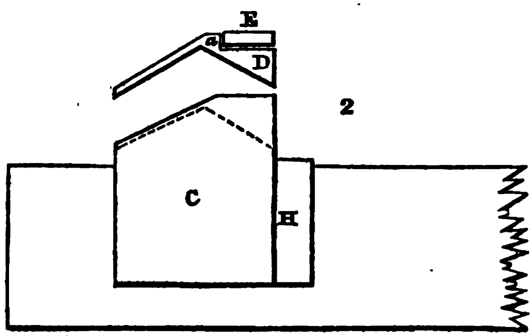


Fig. 1

I sometimes make my rails by taking string pieces of a peculiar form on their upper sides, and upon these I put edge rails, by means of chairs adapted to the form of such string pieces. Fig. 1, in the accompanying drawing, shows a cross section A, of one of the string pieces of timber, and a side view, B, of a chair adapted thereto. These string pieces may be of any convenient length and size, but it will be found best to make them larger than those ordinarily used? Twelve inches in height and two in thickness, I should prefer. It will be seen by the section that the string piece is made ridge-shaped on the top; the angle formed by the sloping sides may vary considerably, but a descent of two inches and a half on each side will answer all the purposes intended. Instead of descending from the ridge, or middle part, in a straight line, it may do so in one which is somewhat concave, or convex; the chair, in this case, being adapted thereto. The same remark will apply to the blocks of wood, or stone, hereafter to be described. The chair B, is so formed on its under side as to adapt it to the ridge-formed string piece across which it is made to straddle. Such chair, so formed, and firmly attached to string pieces, will afford greater stability, being less liable to displacement, and resisting the lateral thrust more effectually than any mode of forming and fixing such articles, now in use.

When it is desired to use a plate rail, the top of the string-piece must be adapted thereto. In fig 2, is shown a section of such a rail

and plate, together with the kind of chair which I have invented, and adapted to be used with rails of that description. The upper sides of the string pieces are, in this kind of rail, sloped towards the outer edge only, commencing from a point immediately under the outer edge of the iron rail plate; C, in this fig. is the section of the string piece, D, the chair, and E, the rail plate. The chair is made in the form shewn in the drawing. The chair is to be let into the string piece, so that its top shall be flush with the top thereof. There is a shoulder, offset, or jog, at *a*, to steady the rail plate; this shoulder may be extended up within an eighth of an inch of the surface of the plate. These chairs I make of cast-iron of such strength as is necessary to sustain the load; they, however, will be found but little liable to fracture when properly imbedded in the rail. The distance of these chairs from each other may vary from eighteen inches to three feet.



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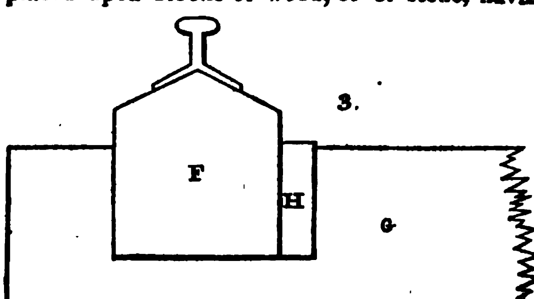
The dotted line shows the depth to which the chair may be let in to the string-piece.

Fig. 3, represents a cross section of a rail-road, and exhibits an improved mode of construction, in which the rail, or the chair which supports it, is placed upon blocks of wood, or of stone, having the upper



3.

surfaces of such blocks ridge-formed, in the same way with the string pieces first described. F, are blocks of stone, or of wood, the upper sides of which are ridged-shaped, and their lower let into the cross tie-piece, G, and secured there by means of wedges, H. The tie pieces may vary in size, but abundant strength is a point of much importance: I contemplate having them, usually, about eight feet long, fourteen inches broad, and eight inches thick, and then make the notches to re-

ceive the blocks four inches deep. The rail may be made so as to be used without chairs, in which case its form will be somewhat like that of the T rail, the lower side, however, being rolled in such a shape as to adapt it to the ridge of the block, upon which shape its stability will greatly depend. Edge rails of any of the ordinary forms may be used by employing chairs adapted to them, and to the ridge-formed block. In a road so constructed a stone block foundation will possess the requisite elasticity, from its resting upon the wooden tie piece. If preferred, a similar advantage may be obtained by imbedding the stone blocks on a rubble foundation in the usual way, leaving their upper surfaces flat, and securing the tie pieces above instead of below them. The ends of the tie pieces are, in this case, to be notched, or cut, into such a form as to adapt them to the kind of chair, or rail, above described, that is to say, they must, when these are seated upon them, be ridge-formed.

What I claim as constituting my improvements in the mode of constructing rail-roads, is the giving to the upper sides of the string pieces, blocks, or cross-ties, the ridged form, as herein set forth, for the purpose of receiving chairs, or rails, adapted thereto on their under sides. I also claim the forming of the string pieces with a slope or chamfer, along one side of their upper surfaces, when plate rails are used, and the construction and application of chairs, such as are herein described, to the fixing and sustaining of the rail plates, by which means the plate is enabled to resist the lateral pressure to which it is subjected; and the great strain upon the spikes, and the indentation of the timber, are obviated. I likewise claim the application of cross ties of wood, either below, or above the blocks of stone, or of wood, which make a part of the foundation of a rail-road, in the manner, and for the purpose, fully made known in the foregoing specification.

ISAAC COOPER.

Specification of a Patent for a process for purifying Salt-water, preparatory to manufacturing Salt; granted to NILS SHOLTEWSKII VAN SCHOULTZ, *Salina, Onondaga county, New York, July 23rd,* 1837.

To all whom it may concern be it known, that I, Nils Sholtewskii Van Schoultz, of Salina, in the county of Onondaga, and State of New York, have invented a new and useful mode of purifying salt water, used for the manufacturing of fine and coarse *salt*, and I do hereby declare that the following is a full and exact description thereof.

The nature of my invention and discovery consists in decomposing the impurities kept in solution by the salt water, which impurities chiefly consist of muriate of magnesia, sulphate of magnesia, muriate of lime, sulphate of lime, sulphate of soda, carbonate of iron, iodine and a bituminous oil, &c. &c.; this decomposition is performed, before the salt water is drawn into the kettles, or pans, in the ordinary wooden cisterns belonging to the salt works, if said cisterns are of such dimensions that they contain sufficient water for twenty four hours consumption in the respective works. But as the impurities must have time to sink to the bottoms of the cisterns, before passing into the kettles, or pans, three cisterns, at least, must be attached to each saltwork, each cistern

containing water enough for twenty four hours' boiling, thus permitting the water to settle during forty eight hours.

To enable others skilled in the art to use my invention, or discovery, I will proceed to describe the operation; first remarking, however, that salt waters contained in different wells, differ from each other in their composition, wherefore a different method for purifying the salt water in one class of wells must be used, when compared with the method of purifying the water drawn from the second class of wells.

Salt wells may be divided into two classes. In *the first class*, the impurities consisting of sulphate of lime and carbonate of lime predominate; and the salt manufactured out of that water will be highly impure, by containing the two above named impurities; more or less, in proportion to what the water held in solution before the evaporation. In the *second class*, the impurities consisting of muriate of magnesia and muriate of lime predominate, and the salt manufactured out of that water will not only be impure by containing these two substances, but will never dry in consequence of the two deliquescent salts which continually absorb water from the atmosphere, whereby a continual draining is occasioned, with a consequent loss of salt.

The salt wells at Onondaga, in the State of New York, belong to the first class; the salt wells at Kanhawa, in the State of Virginia, belong to the second class.

For purifying the salt well-water of the *first class*, or where sulphate and carbonate of lime predominate, I take the following method.

For a wooden cistern containing six hundred cubic feet of water, I throw in fifty bushels of charcoal (or mineral coal, if attention is paid to the quantity of carbon contained in the said mineral coal;) then I fill the cistern with the salt-water; when full, *one pound and two ounces* of alum is thrown in and the water is well stirred; then left to settle during forty-eight hours, after which time it is fit for use.

For purifying the salt well-water of the *second class*, or where muriate of magnesia and muriate of lime predominate, I take the following method.

For a wooden cistern containing five thousand cubic feet of water, I throw in one hundred bushels of mineral coal; then I begin to fill the cistern; when half full, I throw into the water one sixteenth part of a bushel of *quick lime* and stir the water; when the cistern is full, *three* pounds of alum are thrown in, the water stirred and left to settle during forty eight hours, after which time it is fit for use. The lime is here used for the decomposition of the muriate of magnesia, precipitating the magnesia and forming with the muriatic acid muriate of lime, which latter is decomposed by the influence of the coal and alum. The lime must first be thrown in and then the alum, because if the order is reversed the lime would act on the alum and decompose it.

To use lime for the purifying of salt well-water, belonging to the first class, for instance at Onondaga in the State of New York, would not only be useless, but hurtful; inasmuch as the lime, decomposing none of the impurities, would be found in the salt.

The above mentioned quantity of coal will be sufficient for a month, but the other substances, alum and lime, must be used every time a cistern is filled.

When the presence of *Iodine* is so great that it corrodes the vessels, I use one fourth part of an ounce of *sulphate of manganese*, which, enveloped in paper, is thrown into the cistern, and is to be renewed every fourteenth day.

What I claim as my mode and discovery, and desire to secure by Letters Patent, is the united effect of *carbon*, *alum*, and *lime*, and *sulphate of Manganese* in the salt well-water, for the purpose of purifying said waters, for the use of manufacturing salt.

N. Sholtewskii Von Schoultz.

Progress of Physical Science.

On the formation of Hail. By M. De la Rive.

(Continued from page 209.)

After having remarked the direction of the storm, and rested for a moment from my fatigue and alarm, I reached the Puy-du-Dôme, a magnificent observatory, where I was still near the clouds. It was now two o'clock, and the state of the skies made me fear other heavy showers, which I was solicitous of avoiding. I then directed my steps towards the Puy-des-Goules, between two and three miles from the top of Puy-du-Dôme, and I ascended it about three o'clock. The heavens were very much in the same state, the two strata of clouds were still apparent, and the south wind, which was very cold, scudded with great strength along the sides of the mountain. It brought along with it another hail-cloud, which appeared to be heavily charged, and in which I was enveloped for about five minutes. The hailstones were numerous, and the largest was scarcely the size of a filbert. They were formed of concentric layers, more or less transparent, and were roundish or slightly oval; they were all carried along in a horizontal direction with great velocity, from which the attraction of the mountain seemed to make them swerve, and many fell upon its sides. Very many struck me without doing me any injury, and they fell as soon as they touched me. The greater part of the cloud passed over my head, and I distinctly heard the hissing noise of the hailstones, or rather a confused noise, the result of an infinite number of partial sounds, which I could attribute to nothing else than the friction of each hailstone against the air. The cloud which passed over my head, and in which all the hail was formed, allowed none to escape beyond half a league from the spot on which I was standing. Some, however, fell on the northern side of the mountain which intercepted its progress, and I collected a certain number of the hailstones in a phial. I subsequently submitted the water to many chemical tests, and I obtained a sensible precipitate, with nitrate of silver and muriate of barytes.

All the hailstones appeared to be subjected to a very rapid rotary motion, but in different directions, so far as I could judge by examining their movements at the moment of their fall on the crown of my hat, which I held as much horizontal as possible to receive them. Many other clouds, charged with hail, still rose from the south, and now on one point, and now on another, it hailed without interruption from one till four o'clock on the chain of the Puys, from Mont Dore, as far as Riom and Volvic.

Between four and five o'clock the hail ceased; the clouds now formed only a single stratum, but they often presented that phenomenon I had noticed in the morning, viz: that they grouped together, and then poured out, along with flashes of lightning, enormous quantities of water. The south wind also had now ceased, the west alone blew, and carried along with it these frightful waterfalls. One of them discharged itself in my view at Barraque, on the great road to Clermont. I was distant from it about forty yards, and not a drop of water fell on me. A heavily loaded carriage which was at a little distance, disappeared in the twinkling of an eye, under the mass of water which the heavens poured down upon it. After the passage of the water-spout, it was overturned in a ditch, and the postilions, for a time, did not try to right it, so intense was the darkness in the midst of the storm. Large pieces of pavement and great blocks of granite were carried along by this waterspout, which still hurried away before me, and reached Clermont half an hour before I could arrive. The storm on the second of August was not so rapid in its progress as that of the 28th of July, and it traversed a much shorter line. It began upon the mountains of Cantal, and terminated upon the confines of Auvergne and Bourbonnais. M. L. de Bunch, who, that day, was at Cantal, ineffectually attempted, at ten in the morning, to reach the summit of Puy-Griou, on account of the violence of the wind. My brother-in-law M. Nivet, who was at the Mont Dore, did not perceive the wind at the Pic de Sancy till midday, and I myself, upon the top of Puy-du-Dome, did not perceive its violence till one o'clock, and it was then only that the hail clouds arrived.

Perhaps I may have dwelt somewhat too much in detail upon these phenomena of which I was an eye witness, but I believe I have collected some facts which are new to meteorology, a science which is not very rich in them even at the present day. I shall conclude by endeavouring to sum up, without, however, considering them as quite general, the observations which I have collected on the two occasions I have specified.

Conclusions.

1st. It appears that hail is formed during the prevalence of winds of *impulsion*, and not of those of *inspiration*, which, however, are generally more violent than the former. The storm of the 13th July, 1788, concerning which M. Tassier made a report to *L'Academie des Sciences*, goes to confirm this opinion. Its velocity was nearly the same as that of July 28, 1835.

2d, Two strata of clouds, placed the one over the other, and two winds from different quarters, seem necessary for the production of hail.

3d, The hailstones do not pass from one cloud to another as Volta supposed; on the contrary, they advance with very great horizontal rapidity, and are urged forward by an extremely cold wind.

4th, Electricity nevertheless plays an important part in these phenomena, and, according to all appearance, the superior cloud supports the inferior, heavily loaded with hailstones, and probably in a state of opposite electricity. There is probably also electrical repulsion among the hailstones which form the anterior extremity of the cloud, and which there present the whirlwind-like phenomenon which is so remarkable, and which I have twice observed in the most distinct manner

5th, The hailstones do not strike against each other during their horizontal transport; and the noise which is heard, that rolling murmuring which is perceived at so great a distance, is owing to the combination of the individual sounds produced by each hailstone cutting the air with such swiftness. The clashing of any hailstones during their progress causes them immediately to descend.

6th, We are led to suppose that the hailstones are subjected to a rapid rotary motion, but my opportunities have not yet enabled me distinctly to see it.

7th, The formation of hailstones, and their increase, appear to be owing to cold produced by the evaporation at their surface, on account of their great velocity. The hot air into which the anterior edge of the cloud penetrates, leaves a portion of water deposited upon them, a part of which is evaporated, and thereby congeals the other part, and thus forms concentric layers round the nucleus; the wind unceasingly transports the hailstones into new portions of the air which is saturated with moisture, and the upper cloud supports them in their progress. But the lower cloud rapidly increasing in density, by degrees falls down, and separates itself, more especially on its anterior portion, from the electrical cloud which supports it, till it reaches that point in which the action of this latter is almost nothing, the hailstones being all electrified in the same manner then strongly repel each other, and present that violent agitation which is perceived at the surface of the earth, and which repels in all directions those hailstones which the wind reunites by imposing upon them its own direction.

8th, The presence of long crystals at the opposite poles of the hailstones of the 28th July, 1835, would indicate that those which were placed at the equator were destroyed during their descent by the rotary motion, or that this same movement hindered them from being formed upon the equatorial portion on account of their velocity, whilst they were easily grouped upon the poles.

9th. The water procured from the melting of the hailstones was far from being pure.

From this short review, we may see how necessary it is, especially in meteorology, to guard against too readily generalizing facts. We must first observe, and then observe again, and we must wait till favourable occasions again place us in circumstances where we may see well, and study well, before we propose theories which, like those of Volta, can be supported only upon the reputation of a great name.

Clermont, 1*st February.*

The account which we have just been reading, and the precise results which the author deduces from the facts of which he was an eye witness, appear to be of a nature calculated to throw much light on the still rather obscure subject—the formation of hail. As, moreover, they seem to agree with the view we have taken with regard to this phenomenon, we may be allowed, in concluding this article, to explain briefly the opinions which we have formed on the point.

Electricity, then, always accompanies the formation and fall of hail; but we are often asked if, in correct reasoning, this is a sufficient motive or admitting that the hail owes its existence directly or indirectly to the lectricity:—Is it not possible that the same cause which determines

the formation of the hail, at the same time developes the electricity, and that these two phenomena, instead of being connected as cause and effect, have no other alliance than that which depends on their having a common cause? The new opinions upon electricity with which science has within these few years been enriched, and more especially those which have obtained concerning the different circumstances in which this element may be developed, seem to confirm this conjecture; they seem also to derive a new degree of strength from the observations which have been made by M. Lecoq, and we shall therefore endeavour to develop our views.

The propagation of heat in any body is always accompanied by a development of electricity; and so far as there is any difference of temperature between the different parts of a body, so far is there a rupture of the natural electrical equilibrium. Now, if we consider a vertical column of atmospheric air during a serene calm, when no wind or cloud affects its physical condition, it will represent a body in which the temperature goes on decreasing from the base, which rests upon the earth, to its summit, which is the limit of our atmosphere. The difference of the temperature at the two extremes of this column must be very considerable, since it is admitted that the temperature of the atmosphere at its upper limit is at least —50° Cent. This difference ought also to be greater in summer than in winter, and in hot than in cold countries, since the temperature of the base of the column of air is determined by that of the soil upon which it reposes, whilst the temperature of its summit, being that of the limit of the atmosphere, is every where and at all times the same. This difference of temperature, which extends itself uniformly between all the points of the vertical mass of air, is necessarily the result of a continual propagation of heat from below upwards, and should consequently be accompanied by a development of electricity, the intensity of which should be increased in proportion as it ascends, that is to say, in proportion as the difference of temperature becomes greater. Now this is precisely what we learn from direct observation; we in truth find that the atmosphere, when it is calm and serene, is charged with a positive electricity, whose intensity is continually greater as we ascend. As to the negative electricity, which should accumulate at the base of the column, it is absorbed by the earth; for many observations of various kinds, and amongst others those of De Saussure and of Volta, demonstate that the earth is endowed with a negative electricity.

Taking, then, this view of the matter, which reposes solely upon experiment, and perfectly accords with what we discover in a body heated at one of its extremities, the permanent electrical condition of the atmosphere will essentially depend on the manner in which the heat is distributed, and propagates itself throughout the air, and not upon evaporation, vegetation, or any other cause variable in intensity, and unequally distributed, to which the atmospheric electricity has been erroneously, as we think, attributed. It would be easy to demonstrate that this explanation can account with the greatest accuracy for the variations which atmospheric electricity undergoes; and in particular that it is not in opposition to the fact observed by M. De Saussure, and after him by other naturalists, that this electricity is stronger in winter than in summer. In truth, the greater intensity of atmospheric electricity

during the winter is owing to this circumstance, that the electroscope, by means of which we perceive it, is at this period of the year put into communication with a larger portion of the atmosphere, on account of the moisture with which the air is then almost always saturated.

Should the atmosphere cease to be serene, or should a mass of air loaded with humidity, and carried by the wind, happen, by its mixture with another mass of air, to produce clouds, immediately a new distribution of temperature, and consequently of the electrical condition of the column of air, would be effected. To comprehend this result, we must remember that the solar rays which heat the surface of the earth traverse the atmosphere without sensibly heating it; and that it is the heat emanating from the earth which essentially determines the calorific state of the atmosphere. Now when a vertical column of atmospheric air is divided into two sections by a layer of vapours, or by a cloud more or less thick, the terrestrial heat, not being able, at least wholly, to traverse this layer or this thick cloud, is sent back towards the earth whence it came, instead of penetrating through and beyond it. The portion of the column comprehended between the cloud and the soil preserves, therefore, this heat, whilst the portion included between the cloud and the limit of the atmosphere receives little or no heat; and the more the former of these two portions becomes hot, the more the second must be cold. Thus the column, instead of exhibiting a gradual decrease of temperature from its base to its summit, is found to be divided into two portions, having each a uniform, but very different, temperature. The cloud, more or less thick (or there may be many of them superposed on each other) which separates the two portions, is then very warm on its inferior surface, and very cold on its upper surface. It must, of course, be very strongly electrified, negatively on the one side, and positively on the other; and this electrical condition may be constantly destroyed by the neutralization of the two opposite electricities, which operate across the cloud itself, without however ceasing to exist, since the cause which produces it continues to act, and is ready to reproduce it as rapidly as it disappears. Here, then, we perceive the two strata of clouds of which M. Lecoq speaks; the wind ere long separates them; the atmosphere is speedily filled with clouds, some of which are negatively electrified, and the others positively, without including those which are electrical through the influence of others.

But why, it may be inquired, does this distribution of temperature, which produces so great an accumulation of electricity in the atmosphere, for the most part also produce the phenomenon of hail? In answer to this question, we must recollect, that the thicker the layer of clouds which intercepts the heat from the earth, the colder is the upper portion of the atmospheric column. Its temperature ought to be decidedly inferior to that of ice, for if the cloud completely interrupted all the terrestrial heat, it would be reduced to the temperature of the upper limit of the atmosphere, which is less than —50° Cent.; but there is no necessity it should be so low as this. It is enough that its temperature should be sufficiently low to congeal the drops of water at the upper part of the cloud, and so to freeze them as to render them capable, when impelled by the wind, as noticed by M. Lecoq, to traverse the layers of clouds, and descend towards the earth in consequence of their

weight, at the same time condensing and freezing upon their surface the vapours through which they pass. Thus, the same cause which favours the abundant accumulation of atmospheric electricity in the cloud, will also be that which most assuredly effects the formation of hail. In particular, the immense heat which is usually experienced before a thunder storm, precisely indicates the existence of an invisible stratum, or of a cloud which, placed in some part of the atmosphere above the observer, intercepts the terrestrial heat, and sends it back whence it comes, instead of allowing it to proceed into free space; consequently, the higher the temperature is raised on the surface of the earth at any given time, the more it must be depressed on the other extremity of the column, or on the other side of the cloud, and consequently there must be the greater tendency both to the development of electricity, and to the formation of hail.

Again, the hailstones once formed, enlarge more or less, according to the length of the course which the wind causes them to pursue through the atmosphere; according to the quantity of water which they meet with in this course, and, finally, according to the temperature more or less low which they possess at the moment of their formation. In winter, if they be small, it is owing to the absolute quantity of water which the atmosphere contains being much less; and since at the moment of their formation the temperature is not lower than in summer, they must clearly condense a smaller quantity of water upon their surface, since they encounter less in their passage: they then form what we call *hoar-frost* (gresil.)

We believe, therefore, that hail is formed in the most elevated regions of the atmosphere; where we besides know, from the appearance of halos, that small crystals of ice are often floating. The cloud which carries these small nuclei of hailstones on its upper surface descends obliquely towards the earth through the combined effect of its weight and of the dominant wind. In proportion as it descends, the hailstones increase in size, or diminish and are dissipated, according as they meet in their course clouds, or a dry atmosphere. In the former case, the cloud which conveys them becoming always more and more weighty, at length descends lower than all the others, as has often been remarked, and finally disperses itself upon the ground.

We shall not attempt at present to develope more in detail the ideas which we have now expressed. We should even have waited till a greater number of observations than those which we have already made had furnished us with a more solid groundwork, had not the publication of M. Lecoq presented a favourable occasion for their publication.

Edin. New Philos. Jour.

Mechanics' Register.

Cuir mâché.

Mr. Joseph Esquilant, 25, St. Alban's Street, Lambeth, has recently invented a mode of manufacturing flowers, and other articles for decorating rooms, of leather, prepared in the same manner as paper is for *papier mâché*. The advantage of using this material is, that the articles are tougher and more durable. A specimen, which was shown to us

by Mr. Esquilant, was thrown from one end of the room to the other and pulled at both ends with considerable force, without suffering the slightest injury. We trust some eminent architect will examine this invention, and patronize its author as he deserves.—*Cond.*

Architec. Mag.

The Cuba Railway.

This railway passes from the city of Havanna to the port of Batabano, on the southern side of the island of Cuba, and is eighty miles in length. The purpose for which it has been constructed, is to connect the commerce of the Havanna and the northern side of the island, and also the commerce of New Orleans and various other important parts of the northern side of the Gulf of Mexico, with the West India islands and the Spanish Main. Cuba being an island of upwards of 700 miles in length, but only about 80 miles in average breadth, and lying in a position which requires vessels from the north or the south to sail round it in order to reach the opposite sea, it was projected by the present governor of the island, that a railway should be formed for the purpose of cutting off a navigation of several days, by passing across the island from north to south. It is therefore apparent that the railway is a work of the most important kind, and will tend to improve most materially the commerce, not of the island of Cuba alone, but of the English West India Islands, and of all the countries of the West India seas.

The railway is not perfectly direct in its course from the Havanna to Batabano; as, in the commencement of the undertaking, it was thought expedient to carry the line a few miles eastward of the due course across the island, for the purpose of taking in some very rich and populous villages and sugar plantations which exist upon the way. This deviation, however, will serve as a branch, should the traffic upon the railway prove equal to the expectations of the government, and the course, at a future time, be required to be rendered perfectly direct from sea to sea.

Fifty miles of the line have been completed some months since, and a steam locomotive engine, of great power and size, has been manufactured for it, by the Messrs. Braithwaite, of the New Road. The whole of the levels and other more important works upon the remaining thirty miles, are now also completed; and the rails having been shipped from England about two months since, it is expected that the next arrivals from the Havanna will communicate intelligence of the opening of the entire line.

Lond. Mech. Mag.

East India Caoutchouc.

It is well known that a large supply of this valuable substance might be procured from India, if the same care were to be taken in gathering it as in South America. "The London Caoutchouc Company," impressed with this idea, accordingly sent to India an offer of a premium of fifty pounds for the first hundred weight of East India caoutchouc which should be shipped for England. When the offer arrived, how-

ever, it was somewhat of the latest; the great demand existing at home for the article had been previously heard of, and large quantities were already on shipboard; compared to which the "hundred weight" stipulated for was but a molehill to a mountain! The whole affair forms an apt illustration of the doctrine that, in commerce, the force of self-interest is far superior to that of artificial bounties. Ibid.

Minerals in Jamaica.

The expectations of the Spaniards, which appear to have been disappointed on the first discovery of Jamaica by Columbus, with respect t its mineral riches, appear to be on the eve of being realized, in our days, after an interval of more than three centuries; specimens of copper, gold, silver, lead, and iron ores, of great beauty and richness, having been received in this country from an estate in the vicinity of Kingston. The copper ore is said to yield fifty per cent. of pure metal, and hence appears to be the richest in the world: and a cargo of copper ore shipped from an estate in the parish of St. George, sold as high as £40 per ton. Besides this, a discovery of coal, of excellent quality, has also taken place, and promises to be of vast advantage to the inhabitants.

Mining Journal.

Origin of Coal.

Coal is supposed by some writers to be the remains of antediluvian timber which floated in the waters of the deluge until several mineral strata had been formed; others conceive it to be antediluvian peat bog. It was used in England anterior to the reign of Henry III; for that monarch, in 1234, renewed a charter granted by his father to the inhabitants of Newcastle, by which they were permitted to dig coal on the payment of 100*l.* per annum. Coals had been introduced into London before 1306, for in that year the use of them as fuel had been prohibited, from the supposed tendency of their smoke to corrupt the air. About the beginning of the sixteenth century the best coals were sold in London at the rate of 4s. 1d. per chaldron, and at Newcastle no more than 2s. 6d. for the same. During the ensuing century, however, they were received into such general use, that in 1648, on the scarcity of coal in London, many of the poor were said to have died from the want of fuel. The whole quantity of coal sent into London on an average of four years, has been estimated at 1,170,000 chaldrons per annum. There has been much dispute on the origin of coal, but Brogniart has given the following as the general conclusions of naturalists:—1. That coal was formed at the same time as, or after the existence of, organized bodies. 2. That this mineral when first formed was liquid, and in a great degree of purity. 3. That the same cause which produces this substance is several times renewed in the same places and under the same circumstances. 4. That the cause, whatever it may be, is nearly the same over all the earth, since the beds of coal always exhibit nearly the same phenomena in their structure and accidental circumstances. 5. That these beds have not been deposited by any violent revolution, but on the contrary, in the most tranquil manner, since the organized bodies that are found in them are often found entire, and the leaves of vegetables impressed in the slate which covers the coals are hardly ever bruised or otherwise deranged.—*Merthyr Chronicle.* Ibid.

Lunar Occulations for June 1838.

LUNAR OCCULTATIONS FOR PHILADELPHIA, JUNE 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
9	15	54	Im. 84 p. Sagittarii	,6,	110°	181°
9	16	6	Em.		286	319

Meteorological Observations for December, 1837.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer, sun rise.	Barometer, 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	39	55	30.10	30.10	S.	Moderate.		Fog—clear.
	2	43	62	29.90	29 80	S.W.	do.		Fog—clear.
	3	54	58	54	64	W.	do.		Cloudy—do.
☾	4	39	45	80	84	W.	do.		Cloudy—clear.
	5	30	42	30.15	30.20	W.	do.		Clear—clooudy.
	6	29	45	20	10	W.	do.		Clear—do.
	7	30	43	5	5	W	do.		Clear—do.
	8	32	48	29.81	29.70	W.	Brisk.		Clear—do.
	9	20	21	30.00	82	E.	Moderate.		Cloudy—do.
☺	10	30	32	29.50	50	E.	Brisk.	.35	Rain—cloudy.
	11	32	34	50	60	W.	do.		Clear—cloudy.
	12	28	37	90	90	W.	do.		Clear—clear.
	13	27	40	90	80	W.	Moderate.		Clear—do.
	14	24	32	80	80	W.	do.		Cloudy—clear.
	15	18	27	30.00	30.00	NW.	do.		Clear—do.
	16	19	30	20	20	W.	do.		Clear—cloudy.
	17	22	29	10	29.00	E.	Blustering.		Snow—sleet.
	18	52	43	28.90	10	SW.W.	do.	2.00	Rain—shower
☽	19	30	36	29-60	60	SW.	Moderate.		Clear—cloudy.
	20	25	30	70	70	W.	Brisk.		Clear—do.
	21	20	27	80	83	W.	Moderate.		Clear—cloudy.
	22	20	30	90	30.00	W.	do.		Clear—partially cloudy.
	23	19	32	30.25	25	W.	do.	.3	Clear—snow,
	24	27	34	5	29.95	NW.	do.		Cloudy—clear.
	25	27	36	15	30.15	W.	do.		Clear—do.
	26	33	50	29.85	29.85	W.	do.		Cloudy—clear.
	27	23	34	30.39	30.30	SE.	do.		Clear—do.
⊗	28	23	39	29'96	29.96	E.	do.		Partially cloudy—do. do.
	29	24	32	30. 5	30. 5	SW.	do.		Clear—lightly cloudy.
	30	29	46	29.96	00	W.	do.		Clear—clear.
	31	36	41	30.00	10	ENE.	do.		Clear—do.
	Mean	29.13	38.45	29.90	29.86			2 38	

	Thermometer.	Barometer.
Maximum height during the month.	62.00 on 2nd.	30.30 on 27th,
Minimum do.	18.00 on 15th.	28.90 on 18th.
Mean do.	33.79	29.88

JOURNAL

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AND

MECHANICS' REGISTER.

MAY, 1838.

Practical and Theoretical Mechanics and Chemistry.

Extracts from "Researches as to Lime-burning. By M. Petot, *Engineer of Roads and Bridges.* Translated from the French by J. G. Totten, Lt. Col. of Eng. and Brevet Col. United States Army.*

Article xvii.—*On the preparation of Factitious Puzzolanas, and particularly of that afforded by Gneiss Sand.*

§1. *On different kinds of Puzzolana.*

The important part that puzzolanas play in the improvement of hydraulic mortars, sufficiently explains the interest that belongs to an examination of this subject. As yet we know of no other means of forming mortars susceptible of hardening in water: and even since hydraulic limes have become the subject of particular study, that of puzzolanas has not been the less attended to, because hydraulic limes are not to be found in every locality, nor is it always possible, or economical, to manufacture them; and because in many circumstances they give mediocre results only, unless mixed with a certain dose of puzzolana.

Puzzolanas may be arranged in two principal classes, namely, natural puzzolanas, and artificial puzzolanas. Among the first, the most energetic are, generally, volcanic matters of a composition analogous to clays. These were discovered first in Italy, where their use goes back to time immemorial. Afterwards they were found in countries possessing extinct volcanoes, as Auvergne, Vivarais, Guadeloupe, &c. The matters which furnished them have sustained, by igneous action, a change in the primitive mode of combination in their elements; but as the intensity of this action was not every where the same, there resulted products of various degrees of cohesion: and it is not difficult to conceive that great differences may exist in their qualities, although none may exist in their chemical composition.

It may, nevertheless, be possible that a puzzolana is no more than of medium quality, merely because, as is said in common parlance, it is still *too*

*Paris, from the Royal press, 1833.

young. In cases where there was at first too much cohesion, certain influences may, in the course of time, bring about a state of disaggregation. This phenomenon is not without example in nature: the greater part of the feldspathic rocks are in these circumstances, and produce a second variety of puzzolanas. Such, particularly, are the graywackes of Carhaix, the arenes of Perigord, and our gneiss sands. The geological position of these substances, at least of the gneiss which we have before us at Brest, does not admit the supposition of any igneous action. This disaggregation goes on little by little, and we take, as it were, nature in the act, for between the upper parts of the quarries which are in a state of sand, and those which are still in the condition of hard rocks, it is not rare to find a series of layers of every intermediate grade of cohesion.

These recent puzzolanas are but slightly energetic: but by torrifying them, they are rendered, if not equal to the first, at least applicable to almost all the same uses: they thereby pass into the class of artificial puzzolanas.

In the same class we must also arrange, after they have been highly calcined, compact schists, and even basalts. Calcination was, in fact, the means applied to these substances by M. Gratien Lepère, and the Swedish engineer Beggé. Lastly, all clays, considered either as proceeding from the decomposition of rocks, or as forming particular earths, lead to the same result by the application of heat.

Few localities are without clays; whence the general use, from very remote periods, of the dust of bricks or tiles, as cement. We may now substitute, with economy, the sands of graywacke, of gneiss, and of arenes; but these latter substances are less common. By their use the subject does not change its aspect; there is merely an enlargement of its boundaries.

In all puzzolanas, natural or factitious, the elements of clay, namely, silex and alumine, determine the hydraulic qualities: moreover, silex alone, in jelly, or lightly calcined, but in a state of extreme division, gives, by its mixture with fat lime, a good hydraulic mortar; while it is not the same with alumine; we may, therefore, say, definitively, that silex is the base of all puzzolanas; and that, reciprocally, all substances containing silex in a state of feeble cohesion are apt to become puzzolanas.'

§2. *On several methods employed in the preparation of Factitious Puzzolanas.*

The study of the quality and use of natural puzzolanas not having immediate connexion with the question before us, we shall restrict our remarks to artificial puzzolanas. And we shall first refer to the several methods applied to their preparation.

The material to which recourse is had, may be submitted to heat, first, in the state of powder; and second, in the state of fragments, either brick shaped, or of irregular forms. In the first case, all refractory, ochreous, or calcareous, clays may afford good puzzolanas by a torrefaction of a few minutes. It will be sufficient to spread the powder in a thin layer on an iron plate, and keep it incandescent from five to twenty-five minutes. M. Vicat, to whom we are indebted for the knowledge of this method, adds, however, that it has not been applied on a large scale, and that it offers some difficulties. M. Girard de Caudembourg assures us, from his own experiments, that when the arene sands have been lightly torrefied, the time required to set under water is shortened, but the hardness of the mortars is not increased. This consequence, founded on a particular case of calci-

nation, does not prove that it is true in general of arenes, more than of graywacke or gneiss.

In the second case the materials are employed either pure, that is to say, in the state nature supplies them, or previously mixed with certain substances designed to facilitate the chemical reaction. This premised, we see, according to Gen. Treussart, that calcareous clay brought to the same degree of calcination as lightly burned bricks, gives good results; and that from this degree up to that of the highest calcination, its energy rapidly diminishes, and at last becomes null; that for ochreous clays, on the contrary, the calcination of lightly burned bricks gives very mediocre results; but that these results are progressively ameliorated up to the degree of burning required to produce good bricks, beyond which it decreases indefinitely; that, lastly, refractory clays also give excellent puzzolanas at the degree of burning which makes good bricks, but they resist better than the ochreous clays the effect of a higher calcination, and do not sensibly lose quality up to a calcination equalling that of common lime. It is, consequently, to be supposed that they attain their maximum less quickly; and such is, without doubt, the reason why Chaptal—submitting to the same mode of calcination refractory clay, sometimes pure, and sometimes mixed with the sulphate of iron, which gave the equivalent of an ochreous clay, found different results, and concluded that the oxide of iron was an element essential, generally, to the success of the operation.

Clays, at the same time ochreous and calcareous, but containing at least a tenth of their weight of lime, like clays simply calcareous, require only a slight calcination. (Treussart.) We may thus, by a slight burning, obtain good puzzolana with an ochreous clay, by impregnating it with a certain quantity of lime, according to the recommendation of Inspector General Bruyére. We might also, with equal success, replace the lime by potash or soda; and such, for example, is what is called *aquafortis cement*, a residue left in the preparation, by means of clay and nitrate of potash, of nitric acid.

At the works on the canal from Nantes to Brest, graywacke, in irregular pieces, was submitted to a degree of heat like that required to furnish good bricks. And, according to M. Vicat, blue schist requires to be heated till it swells up, (*boursoufle*,) and basalt till it melts, (*le basalt doit couler*.)

For the burning of all these materials in fragments, lime kilns or brick kilns may be used. Unfortunately, the uniformity of the burning not being perfect in any of these kilns, fragments are mixed together, some of which are too much, and some too little, burned; and, consequently, there is a mixture of good and bad puzzolana, affording a mediocre result, or at least a result quite inferior to what may be obtained in the laboratory.

If to this be added, the expense necessary to pulverize and sift these same fragments, it will be perceived how important it is to be able to apply on a large scale M. Vicat's method; for with that method nothing is easier than to arrive at a uniform degree of calcination; after which the products need no manipulation. Such was the object in view in constructing the furnace described below. The abundance of the gneiss sand in the quarries of the port of Brest enabled us to avoid the expense of a preliminary pulverization, and at the same time we were enabled to turn to profit the immense quantity of wood chips furnished by the naval constructions.

Note. Then follows in the original:

Description of a furnace for factitious puzzolanas.

Details relative to the various parts of the furnace.
Progress of burning.
Quantity of products obtained.
The furnace being a reverberatory, the cement was spread out upon the hearth in undulating zones, rather thicker near the front than in the rear, or on the sides, and the aperture was closed for twenty to twenty-five minutes. At the end of this time the surface submitted to the flame was renewed, by turning over the substance. Waiting about another twenty minutes, the calcination was sufficient, and the matter was drawn away to give place immediately to another portion. The author then proceeds:

The quantity of puzzolana prepared in this way varied as the furnace was more or less hot; but it became constant after the fifth or sixth day, and amounted regularly to 120 cubic feet in 24 hours. The number of burnings in the same interval was 34; which gave for each burning 3.53 cubic feet of puzzolana and 42 minutes of time.

The first days the furnace was in operation, we withdrew as much as 177 cubic feet in 24 hours. But experience was not slow in demonstrating that too much in quantity was injurious to the quality; and, which is remarkable, this imperfectly burned sand was less energetic than the crude sand. It was not less important to prove, on the other hand, what would happen in prolonging the calcination beyond 42 minutes. To this end, two new essays were made, the one with two hours', and the other with three hours' burning; and we found that under these circumstances, the energy of the puzzolana suffered a little as respects the rapidity of the setting, but remained about the same, as to resistance to rupture, at the end of fifteen months.

It was important to have, as a term of comparison, some trials of the gneiss burned in the state of fragments, according to the process antecedently used. For that purpose we took, at hazard, a considerable stock of powder reduced from fragments burned during twelve to fifteen hours in a lime kiln; and other powder reduced from fragments burned above the lime, in another lime kiln. With the first, the results were inferior to those with the crude sand; with the second, they were sensibly better than the crude sand, but weaker, notwithstanding, than the sand calcined in the reverberatory furnace.

§3. *Comparative experiments with the Puzzolana of Gneiss, taken in different conditions.*

The experiments here mentioned are united in the two following tables.

Table No. XLIII.—*First series of experiments.*

No.	Composition of the mortars.	Time required to set.	Resistance to rupture per 0.394 inch (centimetre) square.	Age of the mortars when broken.	Remarks.
		d's.	lbs.	mo's.	
1	One of lime in paste with two of crude gneiss sand	20	2.35	8	Immersed in sea-water. The time of setting, a little uncertain on account of the surface swelling up.
2	Same with two and a half	20	3.23	do.	
3	Same with two of sand slightly calcined	35	2.04	do.	
4	Same with one of sand do. and one of quartzose sand	?	<0.77	do.	
5	Same with two and a half of gneiss sand calcined for 42 minutes	7	5.37	do.	The resistances to rupture were calculated generally after the formula of Galileo, $2\ Pc = R\ a\ b^2$ wherein P indicates the weight that caused the rupture; *c* the distance of the point of support of the mortar to the point of application of the load; *a*, the breadth of the prism, and *b*, its depth.
6	Same with two do.	7½	5.37	do.	
7	Same with one and a half do.	8	4.03	do.	
8	Same with one do. and one of quartzose sand	20	<0.99	do.	
9	Same with two of pulverised fragments having been heated from twelve to fifteen hours in a lime kiln	34	2.11	do.	
10	Same with one and a half of the same puzzolana	?	<0.97	do.	
11	Same with one of do. and one of quartzose sand	?	<0.75	do.	All the mortars comprised in this table were immediately immersed in sea water.
12	Same with two of pulverized fragments heated more highly than the above	8	3.43	do.	
13	Same with two of do. from another fragment,	7	4.69	do.	

Table No. XLIV.—*Second series of experiments.*

No.	Composition of the mortars.	Time required to set.	Resistance to rupture per 0.394 inch (centimetre) square.	Age of the mortar when broken.	Remarks.
		d's.	lbs.	m's	
14	One of lime in paste with two of gneiss sand calcined for forty-two minutes	8	5.19	15	Tempered stiff and immersed immediately in fresh water.
15	Same with two of sand calcined during two hours	12	5.70	do	
16	Same with two of sand calcined during three hours	20	5.76	do	
17	Like No. 14, but tempered very soft and immersed immediately in fresh water	24	3.04	do	

Table No. XLIV—Continued.

No.	Composition of the mortars.	Time required to set	Resistance to rupture per 0.394 inch (centimetre) square.	Age of the mortar when broken.	Remarks.
			lbs.	mo's	
18	Like No. 15 but a little less soft than No. 17	16	8.96	15	
19	Like No. 16 and about the same consistence as No. 18	20	4.70	do.	It is remarkable that under fresh water the mortars have not the same tendency to swell up as in sea-water.
20	Like No. 14 but allowed to dry for 18 hours before the immersion	12	6.60	do.	
21	Like No. 15 and with the same precaution as No. 20	11	7.17	do.	
22	Like No. 16 and with the same precaution as Nos. 20 and 21 . . .	13	6.60	do.	

§4. *On the influence of the inert portions of gneiss sand.*

The trials Nos. 4, 8 and 11 indicate that the puzzolana of gneiss will not bear any addition of quartzose sand: all the other numbers indicate that when calcined properly it gives mortars that set very soon under salt water or fresh water, but that it acquires in the end, only a moderate hardness. In fact, it can be arranged only in the class of puzzolanas *simply energetic.*

All these results appear to us to be affected by one and the same cause, the presence of inert matter. We know that gneiss, like granite, is formed of quartz in grains, mica and feldspar: but the quartz totally resists spontaneous decomposition; the mica resists it in part, because it is that substance which is seen in the sand of the quarry in countless brilliant spangles: the feldspar alone undergoes chemical alteration, and furnishes the active element of puzzolana. The energy of this puzzolana depends then on the relative quantities of feldspar on the one hand, and of quartz and mica on the other. Several attempts at a separation have given us a mean proportion of about one quarter for the quartz. The mica is much more abundant but difficult to separate. On collecting, by means of a very fine seive, the most pulverulent portions of a well burned sand, it appeared to be extremely charged with mica; and on tempering it with lime in paste, it gave a mortar which did not indurate in water till the end of 24 days; while with the same sand not sifted, the setting of the mortar occurred at the end of the 7th day.

We will add that the proportions of constituents may vary, from one quarry to another, or even in different veins of the same quarry. It was thus, probably, that on one occasion, the calcined sand, taken at hazard from the store house, gave us—*time of setting, five days—resistance to rupture per* 0.394 *inch, (centimetre) square*—11.22 *lbs.—age of the mortar when broken* 5½ *months.*

The energy of the products obtained from the reverberatory furnace ap-

pears then to depend quite as much on the substance used as on the degree of calcination given to it.

§5. *Trials of the same reverberatory furnace in the calcination of plastic clays.*

What we have thus far said of the gneiss sand is applicable, for the greater part, we do not doubt, to graywacke sands and to arenes; but circumstances have not permitted us to verify it.

Plastic clays have the advantage of these feldspathic rocks, in not being mixed with matter essentially inert; in this respect they offer more chances of being converted into very energetic puzzolanas. But can they be treated with success in the reverberatory furnace? We wish to clear up this question, by some trials, of which we will proceed to give an account.

We made use of the common clay of Brest, which is ochreous and eminently plastic. After having cut it into small slices by means of a wire, and having dried these little slices in the air, they were reduced to powder, or rather they were ground, in an apparatus, of which a description would be useless at this time, but which may be said to be founded on the same principle as a *coffee-mill.* The clay brought to this state was introduced into the furnace, as the gneiss sand had been, and was heated with the same kind of fuel, first for forty-two minutes, then for two hours, and afterward for three hours. We had thus three kinds of puzzolana, which, used in the fabrication of mortars, gave:

The 1*st. an imperfect hardening—a tendency to form paste with water;*

The 2*nd. hardened in twenty days—resistance to rupture after fifteen months*, 3.17 *lbs;*

The 3*rd, hardened in eleven days, resistance to rupture after fifteen months*, 6.86 *lbs.*

At the same time we found:

That with puzzolana from well burned square tiles, the hardening took place in 7 *days; and the resistance to rupture, after eight months, was* 14.30 *lbs: that with puzzolana from Italy, the hardening took place in seven days, and the resistance to rupture, after eight months was* 16.35 *lbs.*

Whence we see that the degree of heat afforded by our reverberatory furnace is insufficient to give to plastic clays all the energy of which they are susceptible. It might be otherwise if we were to use a better fuel: but it is not the less demonstrated that, as regards calcination, we cannot place gneiss sands and plastic clays in the same list. As to these last, one consideration is striking; which is, that if the calcination be not perfectly uniform, all those portions which retain a tendency to form paste with water, will become an obstacle to the setting of the mortar, and a permanent cause of alteration. The gneiss sands, on the contrary, act even in their natural state, like puzzolana; and, in the most unfavourable case, give a mixture of portions, only more or less active.

§6. *On calcination on a small scale, upon thin iron plates.*

The results we have just been exposing do not at all conform to the manner in which the preparation of factitious puzzolanas, by heating pulverulent substances on plates of sheet iron, has been considered. *An incandescence for a few minutes—a very moderate burning*, compared to what is required in the burning of lime on a large scale, or even in the burning of bricks, carries with it the idea of a degree of heat easy to attain; and, con-

sequently, of the necessity of a particular influence exerted by the contact of atmospheric air. It will not, therefore, be without interest to rectify this opinion by new experiments, which, besides, lead to some other remarks.

On exposing iron plates to the fire in a common fire place, the degree of heat obtained is too feeble: for the clay in powder, heated in this way during 10, 20, 30, 45, and 60 minutes, gave a puzzolana still forming paste with water, excepting the last, which was passible. Under the same circumstances, limestone reduced to powder, did not lose beyond 6 or 8 per cent. of its weight. In order to obtain greater heat, and to operate with more promptitude, we placed plates of sheet iron in a small forge over a fire of charcoal, we then found, for 100 grammes of powdered hydraulic limestone containing 33 per cent. of carbonic acid, duration of calcination—10 minutes—15 minutes—20 minutes—45 minutes: corresponding loss of weight —8.33 gms.—30.00 gms.—32.85 gms.—33.00 gms.

The last three specimens, sprinkled with water, slaked and swelled like ordinary lime just from the kiln. In a few minutes, therefore, the same effects are produced by ignition on a plate of sheet iron, as after several days of burning in a kiln.

To ascertain what would happen on replacing the powdered limestone by powdered clay, we made two series of experiments, one on gneiss sand, and the other on an ochreous clay: mortars were made of the resulting puzzolanas; and we deduced from the experiments the two following tables.

Table XLV. *Gneiss Sand.*

Duration of the calcination.	0	3½′	5′	7½′	10′	15′	20′	40′	60′	120′	B. It was notalways possible to ascertain exactly the loss of weight, on account of the adherence of the sand to the iron.
Loss of weight on 100 grammes		gms. 6.20	g. 6.30	g. ?	g. 7.30	g. ?	g. 7.15	g. ?	g. ?	g. ?	
Order in which the hardening under water occurred	4	3	1	1	1	2	3	4	5	5	The hardness was measured bythe weight necessary to force into the mortar a wire 0.047 of an inch in diameter.
Hardness after two months.	Soft and without consistence	gms. 400	g. 800	g. 800	g. 800	g 800	g. 500	g. 300	g. 250	g. 180	

Table No. XLVI. *Powdered ochreous clay.*

Duration of the calcination.	5′	7′	10′	15′	20′	25′	30′	40′	60′	120	The first two specimens were heated more violently than common. The clay adhered to the sheet-iron.
Loss of weight on 100 grammes.	?	?	gms. 9.50	g. 9.65	g. 1160	g. ?	g. 12.20	g. 12.50	g. ?	g. ?	
Order in which the hardening under water occured	4	3	3	2	1	1	2	4	5	6	All the puzzolanas mentioned in these two tables, were of a decided red, except the first, which had the natural colour of the sand.
Hardness after 2 months.	gs. 900	g. 1000	g. 1000	g. 1100	g. 1500	g. 1500	g. 1200	g. 600	g. 500	g. 200	

These tables show that the degree of heat necessary to convert ochreous clay into good puzzolana differs but little from that necessary to the complete calcination of lime, and may, consequently, be assimilated to that required to produce good bricks: that for the gneiss sand, as we have already shown, a much lighter calcination will suffice, and which, on a large scale, should not exceed the calcination given to slightly burned bricks. Nothing as yet shows the truth of the hypothesis, that the contact of the air exercises a particular influence on the calcination of any argillaceous substances whatever, on plates of iron. It is objected, it is true, that the same substances calcined in close vessels do not give the same results; but there is nothing in that which should surprise us, as we will attempt to prove.

§7. *On calcination in Close Vessels.*

We operated in a melting furnace with crucibles of about 4½ quarts: instead, however, of four hours' fire required for melting trass, we limited our fire to two hours. The first crucible containing gneiss sand, contained, besides, several small fragments of hydraulic limestone, weighing about ⅛ of a pound each, and so disposed, that after the exposure to the fire, we could ascertain, by their aid, as by a pyrometer, the relative intensities of the heat in different parts of the mass. We here see what happened.

1st. In the high and central parts of the crucible, the gneiss sand neither changed colour nor consistence: and the calcareous pieces lost only five or six hundredths of their weight.

2nd. In the enveloping layer, the sand, slightly agglutinated, had taken a pale gray slate colour; and the calcareous pieces, rather more burned than the preceding, gave a pellicle of lime which slaked in contact with the air.

3rd. In the more exterior layer, the sand had the consistence of the scoria of forges, and a decided slate colour. The calcareous fragments were found in the state of perfect lime, but without any indication of supercalcination, or any adherence to the matter surrounding them.

A second crucible, filled with ochreous clay, in powder, which had been dried at a low red heat, gave products altogether analogous; that is to say, gave three distinct species: one of the ordinary red colour, another of a deep purple, and a third of a slate colour.

In the transition from one to the other of these principal products, there necessarily existed a great many shades, difficult, certainly, to isolate, but which did not the less correspond to so many particular degrees of calcination. We may then conclude,

1st. That it is nearly impossible to obtain a homogeneous torrefaction in close vessels.

2nd. That if the substances employed are ochreous, their fusibility will manifest itself at a degree of heat less than that which is necessary for the calcination of lime; which does not happen when in contact with the air on plates of iron.

3rd. That consequently, in these two modes of preparation of puzzolana, the same degrees of heat do not correspond to the same chemical reaction.

4th. That, therefore, not having any thing but the appearance of the substances, to guide us in the choice of terms of comparison, we are liable to oppose to the best puzzolana prepared in contact with the air, another prepared in a close vessel, in which the chemical reaction of the elements

is in a very different state of advancement: and this, whether the clay were ochreous, or simply composed of silex and alumine.

Thus then, as has been already seen, it might happen that two mortars made of different puzzolanas, would acquire, after a certain time, the same hardness without having had, nevertheless, the same promptness of induration. Thus we may say, further, that the variable proportion of alumine soluble in hydrochloric acid, is not a consequence of such or such a mode of calcination, but rather of the difficulty of seizing terms of comparison perfectly exact.

§8. *On the decrease of the energy of Puzzolanas as they approach the point of vitrification.*

The phenomena which will be developed in the following article, taught us the importance of ascertaining whether the diminution in the energy of puzzolanas was progressive as the substances approached the term of vitrification. With this view we collected the preceding puzzolanas, prepared in close vessels, and bearing traces more or less evident, of vitrification. Making mortars of these, we remarked in the first place, that a very small addition of water sufficed to soften them in a singular manner. Be that as it may, the specimens obtained in stiff paste, were immersed the same day; the others were not immersed till the next day, in order to give them time to dry. After fifteen days none of them had acquired any kind of consistence; all being merely inert matter. With time, these results might change, no doubt, but they will not be the less inferior to those of §6.*

If, instead of substances containing the oxide of iron, we had employed those containing lime, potash, or soda, it may be presumed it would have been the same; because the substances we have named all act as fluxes with silex. Thus, therefore, in whatever manner the solidification of mortars may be explained, it is necessary to admit, that puzzolanas require to be deprived of water by heat, and not to have too great cohesion given to them. Whence it results that the most proper degree of calcination cannot be the same for all puzzolanas, but should vary, more or less, according as the substance employed contains more or less water, and a flux more or less energetic.

§9. *The relation between the quality of Puzzolanas and some of their physical properties.*

In indicating the conditions necessary to obtain good puzzolanas, M. Vicat says, (*Résumé sur les mortiers*, page 33,) that the matter ought to have the minimum of specific gravity, and the maximum of absorbent power. If this were rigorously true, it would be an argument against the hypothesis of a chemical reaction in the solidification of puzzolana mortars. We believed it would be interesting to verify this opinion; and to that end, we made the several experiments exhibited in the following tables.

*After a month, these mortars had not improved perceptibly. The specimens made of the puzzolana the most highly calcined were as soft as on the first day. Au.

Table No. XLVII.

Gneiss sand, in several states of calcination.	Weight of substance submitted to experiment.	Weight of substance after 18 days' exposure in a dry place.	Weight of substance after 3 days' exposure in a humid place.	Weight of substance after 7 days' exposure in a humid place.	Maximum increase of weight for 100 parts of the substance.
	Grms.	Grms.	Grms.	Grms.	Grms.
Crude sand highly dried . .	41.90	42.00	42.30	42.30	0.95
Calcined for 3½ minutes . . .	35.75	35.88	36.05	36.05	0.84
Do. 5 do. . . .	35.50	35.60	35.80	35.80	0.84
Do. 7½ do.	36.00	36.10	36.30	36.29	0.83
Do. 10 do. . . .	34.50	34.60	34.75	34.75	0.72
Do. 15 do.	33.75	33.86	34.05	34.04	0.80
Do. 20 do. . . .	34.70	34.80	34.96	34.95	0.75
Do. 40 do.	32.45	32.54	32.67	32.65	0.61
Do. 60 do. . . .	32.30	32.39	32.52	32.50	0.68
Do. 120 do.	30.25	30.44	30.55	30.55	0.66
Calcined in a close vessel, a little melted, (un peu frittée)	55.00		55.20	55.15	0.36
Do. do. more melted	51.70		51.80	51.75	0.20
Do. do. still more melted	49.90		50.00	50.00	0.20

Table No. XLVIII.

Ochreous clay in several states of calcination.	Weight of substance submitted to experiment.	Weight of substance after 18 days' exposure in a dry place.	Weight of substance after 3 days' exposure in a humid place.	Same after 7 days' exposure.	Same after 9 days' exposure	Maximum increase of weight for 100 parts of the substance.
	Grms.	Grms.	Grms.	Grms.	Grms.	Grms.
Calcined during 5 minutes .	26.55	26.59	26.85	26.95	26.94	1.50
Do. 7 do. .	27.00	27.17	27.45	27.54	27.54	2.00
Do. 10 do. .	32.45	32.49	32.90	33.05	33.04	1.85
Do. 15 do. .	32.15	32.20	32.65	32.74	32.72	1.77
Do. 20 do. .	29.20	29.22	29.58	29.63	29.65	1.52
Do. 25 do. .	31.70	31.75	32.03	32.12	32.15	1.40
Do. 30 do. .	29.65	29.70	29.95	30.03	30.05	1.33
Do. 40 do. .	29.25	29.26	29.50	29.57	29.57	1.08
Do. 60 do. .	36.70	36.74	37.05	37.20	37.20	1.36
Do. 120 do. .	19.00	19.04	19.20	19.25	19.25	1.31
Calcined in a close vessel, a little melted, (un peu frittée) .	54.65		54.74	54.80	54.76	0.27
Do. do. more calcined	55.40		55.53	55.60	55.60	0.36

These two tables show, 1st, that puzzolanas exposed in a dry place have a very weak absorbent power; 2d, that this absorbent power augments, in a very sensible manner, in a wet place, a circumstance which renders the condensation of gas, admitted by some persons, but little probable; 3d, that this power is at its maximum before the gneiss sand or the clay had acquired the most advantageous degree of calcination; 4th, that it is not equal, by a considerable difference, in the two kinds of puzzolana, and in this respect it gives a tolerably correct idea of the relative energies; 5th, and lastly, that the vapour of water thus condensed does not enter into

combination with the fixed matter, for it escapes, though in a small quantity, by a simple hygrometric variation in the atmosphere.

Experiments show that in taking bricks in several states of calcination, and immersing them in water, the proportion of liquid absorbed is greater for bricks but slightly burned, than for bricks more burned; that is to say, it is greater for bricks which give only a mediocre puzzolana, than for those which give a good puzzolana. The same experiments will also show that dry clay, before reaching the term of good burning, augments its volume in passing through the term of half burning; and that in this last state, the density of the brick is less than in the preceding. The maximum of energy, therefore, neither corresponds to the maximum of density, nor to the maximum of absorbent power.

Article XVIII.—*On the Preparation—the Preservation—and the Use of Plastic Cements.*

§10. *On Lime Stones which serve for the preparation of Plastic Cements.*

When a lime stone contains about twenty per cent., or more, of its weight of clay, it may furnish the substance known under the names of *plastic cement—Parker's cement—Roman cement.* This substance has the property of hardening very soon, like plaster of Paris; but it has also the further property of indurating under water, like the hydraulic limes. These plastic cements present characters so peculiar, in their preparation and in their use—they have, besides, acquired so high an interest in France since the creation of the establishment of Pouilly, that we have thought proper to appropriate to them a special article, the better to insist on several observations of which the importance will be easily seen.

Until within a few years, plastic cement was a production exclusively English. It was principally near the Thames that the stone, proper for its fabrication, was found. In 1802, similar stone was found on the sea shore, at Boulogne, but in rolled pebbles, and in too small quantity to become an object of regular preparation. It exists also at Baye, near Nevers, according to M. Vicat; in Russia, according to Messrs. Lamé and Clappeyron, and, no doubt, in many other localities; but up to the present time the researches of M. Lacordaire, at Pouilly, are the only ones which have produced very positive results, on a large scale, in France.

The stone from which the English cement is derived, appertains to the upper steps of the secondary, lias formation. It is ordinarily found in rounded masses in the middle of marley strata. That of Pouilly appertains to the same geological formation: such a coincidence leads us to conclude that this kind of formation is most favourable to new investigations. However that may be, the following are analyses of plastic cements already known:

English cement—carbonic acid deducted	55.4	of lime,	44.6	of clay.
Cement of Boulogne pebbles	54.0	do.	46.0	do.
Pouilly cement—first variety	42.86	do.	57.14	do.
The same—second do.	36.37	do.	63.63	do.
Russian cement	62.00	do.	38.00	do.
Cement of Baye	21.62	do.	78.38	do.

§11. *Mode of preparation followed by Parker.*

It was in 1796 that Parker first indicated the means of converting into cement, the very argillaceous lime stones found in roundish masses, and called *septaria.* His process consisted, essentially, in pushing the calcination of the stone to vitrification: and he took out, for his process, a patent in which are the following details:

"The stones are first broken into small fragments: then burned in a kiln as is commonly done with lime, at a heat sufficient to vitrify them; afterward reduced to powder by a mechanical or other operation. The powder thus obtained is the base of the cement. To compose this cement in the most advantageous manner, two parts of water are mixed with five parts of powder, and stirred and beaten to effect a mixture. The cement thus made ought to set or harden in ten or twenty minutes either in air or in water." (Extract of a report of M. Mallet to the *Société d'Encouragement.*)

Parker not having succeeded in his enterprise, and his process having been abandoned, it was generally supposed that he was mistaken, founding the opinion on what happens with fat lime too highly calcined. But here analogy fails, as we shall soon show by experiment.

§12. *Mode of preparation followed by the successors of Parker.*

The plastic cement which now circulates in trade should not be designated by the name of Parker's cement, for there is a capital difference in the preparation. We are ignorant whether the successors of Parker have given a description of their process; but it is easy to judge of the means by the end. Their cement, in fact, treated with muriatic acid, causes a notable quantity of carbonic acid gas to escape. It has besides an ochreous colour resembling that of the natural stone, and differing much from that which may be given it by vitrification. There is no doubt, therefore, that the cement is formed of the septaria *incompletely calcined.*

As to the method followed by M. Lacordaire, M. Mallet, at page 12 of the report already cited, says:

"The stone is explored by blasting with powder in pits and galleries, at a mean depth of about 262 feet. The selection of stone is made above ground, where it is broken into pieces the size of the fist, and carried to the kiln, which is of the kind called *fours contans ou à feu continu* (continual fire.) The stone, when burned and brought to the state of lime, is ground under a pair of cast iron cylinders weighing about 5300 lbs. . . .
. . . The cement is afterwards passed through sieves formed of iron wire separated 0.06 of an inch; by this first operation, a cement is obtained which is called No. 2. This is then passed through a bolting machine also formed of iron wire, but with finer meshes; and it is then called No. 1."

M. Mallet no where says that the cement is incompletely calcined; but it would be a mistake to suppose otherwise. It is, besides, easy to prove it; for the cement tried with acids, permits, as in the English cement, a notable quantity of carbonic acid to escape.

§13. *As to what occurs to Plastic Cements at the point of complete calcination.*

We see from what precedes, that it is equally possible to obtain plastic cements by super-calcination and by incomplete calcination.* But the

*The existence, at the same time, of two means of preparing plastic cement, and the obscurity in which the method of Parker remained, has occasioned more than one mis-

fact most worthy of remark is, that at the point of *complete calcination*, not only the stone does not slake, but if it be treated like ordinary cement, it gives a substance nearly inert. All this is the reverse of fat lime; and it is impossible to confound one substance with the other.

This instant of inertia of plastic cements, between the points of incomplete calcination and supercalcination, seems to us a capital fact in the study of the substances. It explains how a suitable lime stone might escape discovery and be rejected as unsuitable, from a simple fault of calcination, which would not be a fault with fat lime, or with hydraulic lime. In this category we may cite the trials of Gen. Treussart of the Boulogne pebbles. He calcined the stone in the middle of the common lime in an Alsace lime kiln: he was thus led to anomalies which we now easily comprehend.

Note. The author then refers to Nos. 1, 4, 6, 7, 9, *and* 12, *of table No. VIII, of the preceding work of Gen. Treussart.* (*Jour. Frank. Ins. Vol. XX, p.* 320.)

M. Vicat, effecting the calcination by the same means, no doubt, found that the cement of Baye did not harden till after three days' immersion. This would not be a long time for hydraulic lime, but it is unreasonably long for a plastic cement, which the Baye lime stone, from its composition, may be considered to be. The proportion of clay is so great in this cement, that we think it must contain a notable quantity of silex in grains; otherwise, it does not comprise a larger proportion of lime than the artificial mixtures of M. Bruyère, and like them would afford only a puzzolana and not a plastic cement.

§14. *Experiments on the English Cement, and on the English Cement Stone.*

We will now detail the experiments that have led us to a knowledge of these alternations of good and bad quality in plastic cements—beginning with the English cement.

1st. The English stone that we had at command was of a yellowish colour, and very compact texture. After having broken it into small pieces, and placed it in a crucible, we heated it in a laboratory furnace furnished with its dome, up to the complete disengagement of the carbonic acid—as proved by pieces taken from the upper part of the crucible. But owing to the inequality of calcination in a vertical direction, a great number of fragments were found, agglutinated, fritty, and blackened. They were separated with care, and gave by trituration, a powder of blackish gray. Not knowing, at that time, the process of Parker, we thought that all the supercalcined stone must be good for nothing: and it was only to acquire a direct proof thereof that we tempered this powder with water. After a few minutes, to our surprise, the first specimen had hardened. A second specimen prepared and put under water, showed that the induration was comple in less than fifteen minutes.

take. M. Hassenfratz, for example, says in his treatise on mortars, page 195, "The calcination of this stone (Boulogne pebbles) is the same as that of ordinary lime; if it is too much heated, it vitrifies and is no longer proper for making cement." And further on (page 197) he adds, "At London they calcine, in conical furnaces with a central fire of sea coal, the lime stone of which they make Roman cement: but the management of the fire demands much attention, because when the heat is not properly adjusted, the cement sustains an incipient fusion, and is no longer proper for any use." He had, notwithstanding, said (p. 126) that the Boulogne pebbles, strongly calcined, and for a long time, gave a lime which hardens easily, and that this hardening became equal to that of stone, at least; but when it is only calcined to the same degree as fat lime, the cement does not harden with the same facility, nor so much. AUTHOR.

All the stone that was in the upper part of the crucible had escaped any sensible change of colour: pounded and sifted, it was of an earthy yellow; a mortar of stiff clayey consistence was made of it, and immediately placed under water without any envelope. It did not fall to pieces in the water, but, twenty days after, it remained in the same state, that is to say, like a substance wholly inert. A small portion of the same mortar, exposed to the air, had set in one hour and twenty-five minutes, and fifty days after had acquired great hardness.

Another portion of this same yellow powder was mixed with an equal volume of fat lime, to ascertain whether it would act like puzzolana. This mortar, examined for fifteen successive days, comported itself like the unmixed cement; but after about a month, it had set.

2d. The English cement on which we experimented was derived from a stock collected in July, 1824, for the naval works; it had therefore been on hand five years and a half. It was damaged; but we shall show further on that a very feeble heat sufficed to impart much energy to it—causing it to set in fourteen minutes. We filled a crucible with this cement and heated it: the unequal action of the heat enabled us to divide the cement into three portions, in appearance very distinct.

The first part, treated with muriatic acid, liberated no gas; a perceptible change of colour, and a slight agglutination, attested that there had been a commencement of super-calcination. A mortar was made of it, and immediately immersed: The setting was not complete till after six and a half hours.

In the next portion the beginning of super-calcination was more manifest; it should have been triturated and sifted anew, and this operation having been omitted, we think that a diminution of energy was the consequence. However this may have been, after its immersion the edges crumbled off, but the setting was complete in three hours and forty minutes.

Lastly, the third portion, which was from the bottom of the crucible, was *fritty* and *drossy;* it gave a powder of a slate blue colour. A little of it was made into mortar, and made to fill the bottom of a glass: this being put under water appeared hard in thirty-three minutes. A second larger specimen was immersed, not being supported on the sides: the edges did not crumble in the least, and at the end of forty-eight minutes it had well set.

§15. *Similar experiments with the Pouilly Cement.*

Not having the Pouilly cement at command, we were not able to operate throughout as in the other case: but this circumstance need not, we think, be much regretted, since the cement in powder, with which we were supplied, still retained much carbonic acid, and would enable us to ascertain, equally, the effects of complete calcination and of super-calcination.

The Pouilly cement, revived by a new calcination of a few minutes, like the English cement, sets in the air in five minutes. A crucible filled with cement, already deteriorated, was calcined in a heat not very great: cement taken from the top of the crucible, had not lost its carbonic acid, and set under water in eight minutes and a half: the remainder was divided into two specimens which indurated in the air, one in eleven minutes, and the other in sixteen minutes. These cements, at the moment of setting, disengaged heat in a remarkable manner.

Another crucible filled with the same, having been heated more violently, the first portions of powder, tested by muriatic acid, retained hardly any traces of gas; they afforded a mortar, which, exposed to the air, disengaged

a little heat, and hardened in thirty-six minutes. At this moment it was immersed, but soon split to pieces, softened, and preserved its consistency only in a few places. After fifty days, it was found totally reduced, and decomposed into friable lumps.

The remainder of the contents of the crucible was divided into two portions. The first, containing much that was agglutinated, required to be pulverized again; it gave a mortar that hardened in the air in twenty-one minutes, and preserved its form, well, after immersion. The second, completely converted into scoria, became, in powder, of a blue purple: converted into mortar, it hardened in the air in twenty-six minutes, and did not lose its consistency in water.

§16. *Indications, touching the preceding experiments, given by the proof of Rupture.*

It became interesting to complete these experiments, trying the proof, or test, of rupture; and such is the object of the following table: but we have some previous observations to make.

Plastic cements acquire a strong consistence in a short time. For example, the experiments of M. Leroux at Cherbourg, reported in the memoir of M. Mallet already quoted, were made after about fifty days, and gave very satisfactory results. We have operated, with a shorter interval: but it is possible that two mortars may be equal at the end of the year, and not at any briefer period, especially when one is immersed, the other exposed to the air, and when the volumes are very small. But we could not avoid this last inconvenience, because, from being obliged to separate the products into several portions, the bulk of each particular kind was necessarily small. For each specimen we never had more than fifteen cubic inches of mortar: the numbers that we are to submit must therefore be received with caution, and only as stating the hydraulic qualities of the substances.

Table No. XLIX.

No.	Substances employed.	Time required to harden.	Resistance to rupture per 0.394 inch (centimetre) square.	Age of the mortars.	Observations.
			lbs.	Days.	
1	English stone completely decarbonated . .			20	Could not be tested.
2	The same stone, with fat lime		1.10	50	Immersed.
3	The same, super-calcined	15′ in water.	6.39	50	Do.
4	English stone, carbonated	14′ in the air.	15.75	35	Exposed to the air.
5	The same . . .	14′ in water.	7.24	35	Immersed.
6	The same reburnt up to super-calcination . .	6 h. and 30′			Put in a glass.
7	The same, super-calcinated more strongly . . .	3 h. and 40′	2.69	35	Immersed.
8	The same, super-calcinated to the state of scoriæ .	48′	5.17	36	Do.
9	Pouilly cement carbonated	5′ in the air.	3.46	34	Do.
10	Do. . . .	16′	1.93	34	Do.
11	Do. . .	11′	4.22	34	Do.
12	The same, completely decarbonated	36′ in the air.		30	Fell to pieces under water.
13	The same, perceptibly fritty	21 in water.	19.07	34	Immersed.
14	The same, in scoriæ .	26′	3.15	34	Do.

§17. *On the alteration of Plastic Cements.*

The English cement delivered at the Port of Brest, in 1824, was preserved in well closed barrels: that which came to us from Pouilly was in a double cask, with an interval of about two inches filled with absorbent powder of common lime or powdered charcoal: this last method is very expensive no doubt, but it is preferable to the first, when the cement is to remain a long time in store. Whatever may be the process, however, the substance, whether it retains a portion of carbonic acid, or has been super-calcinated, will always lose part of its energy.

In fact, the English cement, which in the first place, set under water in twenty-two minutes, required twenty-one hours to set, after it was five years old, without the barrels having been opened or exposed in any humid place. The Pouilly cement which may be made so energetic as to harden in the air in five minutes, required forty-eight minutes as a mean term of the several trials to which we submitted it, after being four months in store. Further, the barrel having been first opened, and then closed less exactly, sufficed to cause the outside layers of cement to afford a mortar the edges of which crumbled under water, and which had not hardened at the end of four hours.

As to the super-calcined cement, that which would harden, in the first instance, in fifteen minutes, was so altered by thirty-nine days' exposure to the air, that it had acquired only a half-consistence during three days that we successively examined it.

Under such circumstances, we may easily see that the mortars are not susceptible of acquiring great hardness. It is true that the diminution in this respect, is not proportioned to the diminution in the energy of setting; but it does not the less follow, that those plastic cements of which the use is deferred, lose the quality the most characteristic, if not the most precious; and that notwithstanding the precaution used in barreling the substance, the evil can only be retarded. Connected with this, if we consider the liability to negligence in the process of calcination and pulverization, we can comprehend how it is that the use of plastic cements has fallen more than once into disfavor; why the manufacturers have been accused of mixing inert matter with their products in order to augment the bulk; and why the great price of these substances, joined to the uncertainty as to their qualities, has deterred many constructors from their use.

§18. *On the chemical phenomenon that accompany the alteration of Plastic Cements.*

We were at first of opinion, from such considerations as are above stated, that it would be preferable to export, instead of the cement, the cement stone before calcination, as is done with plaster of Paris. An augmentation of weight of twenty or thirty per cent. might be compensated by the suppression of the barreling and all other means of preservation. But although we might act thus in certain places, we could not in all places: and there would be no guarantee that the best mode of preparation would be followed every where; or that the quantity of cement needed, would be worth the trouble of calcination.

Examining then, what occurs in the alteration of plastic cements, we in the first place, ascertained that the super-calcined cement, when exposed to the air for thirty-nine days, had absorbed carbonic acid, and we concluded, *a fortiori*, it would be the same with the cement incompletely calcined, because the combination of lime and clay does not, therein, take so much

cohesion; but we have not been able to satisfy ourselves that this gas, often found in cement the quality of which is good, should be hurtful when found under other circumstances; we have considered, as much more probable, that its presence is indifferent in all cases; and that the cements were good only because the lime and the elements of the clay existed therein in a proper state of combination.

We ascertained, afterward, that cements, while they enjoy all their energy, are not soluble in water; or at least the oxalate of ammonia gives to the water in which they have been immersed, scarcely the lightest cloud. The deteriorated cements, on the contrary, give a precipitate quite abundant, and susceptible of being collected.

We noticed, lastly, that the super-calcined cement and the Pouilly cement, which are of a deep colour, become whiter as they deteriorate; and the white parts give to the water in which they are immersed, a cream which is incapable of solidifying.

From these indications we have concluded that the deterioration of cements is accompanied by a chemical disunion between the lime and the clay composing them; that no doubt the lapse of time between the preparation and the use of the cement, may permit a spontaneous decomposition, but that water, either alone or aided by carbonic acid, is the most active cause; and that we may, therefore, restore to these elements all their primitive energy, by submitting them to a new calcination sufficient to drive off the absorbed water, and re-establish the combination between the lime and the clay.

These are the theoretic inductions which determined our researches as to the possibility of making use of damaged cements. Experience has fully confirmed them, as will be seen in due time.

§19. *On the revivification of deteriorated cements.*

Pouilly cement that hardened in the air in twenty three minutes was heated to a low red heat during twenty five minutes, on a plate of iron. After this operation, being tested with muriatic acid, it showed the presence of carbonic acid, as before: converted into mortar it became hot and solidified almost instantly. The setting was perfect in less than five minutes.

Cement of the same kind, heated more violently, and in a crucible, was divided into three portions: the first hardened under water in eight and a half minutes, the second in the air in sixteen minutes, and the third, in eleven minutes. All three, tried by muriatic acid, disengaged much carbonic acid.

English cement, setting under water in twenty one hours, was made red hot on a plate of iron for twenty eight minutes: this operation did not deprive it of its carbonic acid: tempered and immersed, it hardened in thirty-one minutes.

Cement of the same kind heated for about one hour was divided into two parts: the first, retaining still a little carbonic acid, hardened in the air in fourteen minutes, and the second, which was nearly in the same state, hardened under water in fourteen minutes.

English cement supercalcined, exposed to the air during thirty nine days, and which had become incapable of setting under water in two days, was heated on a piece of sheet iron to a red heat for thirty minutes. It retained all the carbonic acid it had absorbed: being tempered and immersed it set completely in thirty-one minutes.

Wishing to apply this operation on a large scale we exposed entire barrels of the deteriorated cement in the reverberatory furnace, in the same way we had exposed the gneiss sand. After this new torrefaction, the English cement which had refused to indurate in less than twenty-one hours, would now set equally hard in twenty-three minutes, at most, either in the air or in the water. In similar circumstances the Pouilly cement which did not harden in less than two or three hours, was brought to give very good results in seven or eight minutes.

There is no doubt then, that at a small expense, and by the aid of a feeble heat, the injury sustained by plastic cements, from remaining too long in store rooms, or exposed in damp places, may be repaired.

§20. *On the recovery of cement mortars already hardened.*

The experiments we have just given caused us to conceive the hope of restoring cements which had hardened after being accidentally moistened and even of restoring mortars themselves. We ascertained that the thing is, in fact possible, but at a much higher temperature.

Mortar made of Pouilly cement, one month old, and already offering a resistance to rupture of about 13 lbs. per 0.394 inch (centimetre) square, was reduced to powder. A portion of this powder made red hot for twenty minutes, gave a mortar which did not become hot and did not harden. Another portion was heated in a crucible for almost one hour: the first layers of cement had visibly changed colour, but had not lost their carbonic acid: they gave a mortar that acted like inert matter. The last layers, on the contrary, were completely decarbonated; a mortar was made of this which increased in temperature sensibly after three minutes' exposure to the air, and hardened after ten minutes; but being then immersed, it split and softened.

Some of the same powder heated more highly in a crucible, and giving some indication of supercalcination, was tempered with water, but, from inadvertency, into too soft a paste. The setting was nevertheless complete after four hours in the air, and it sustained itself well in the water.

Another crucible heated more highly still, gave a mortar which, exposed in the air, took immediately a remarkable consistency; at the end of six minutes, the trial wire gave almost no depression on the surface. There was no heat disengaged at the time of setting.

A last crucible, heated in the same manner, gave also a supercalcined cement which hardened in eight minutes without any disengagement of heat. This specimen and the preceding were immersed immediately; the water did not alter them.

If it be desired to reproduce these results on a large scale, it must not be done in a kiln built to burn puzzolanas, but in a lime kiln; taking care to place the mortar or blocks of hardened cement at the bottom of the charge, in order to obtain the proper degree of supercalcination. We should add, however, that we have not employed this mode of restoration.

§21. *Indications touching the preceding experiments, given by the proof of rupture.*

As in §16, we have united, in the following table, the resistances to rupture of the specimens of mortar of which we have been speaking in the preceding paragraphs.

Table L.

No.	Substances employed.	Time required to harden.	Resistance to rupture per 0.394 in. (centimetre) square.	Age of the mortar.	Remarks.
			lbs.	ds.	
1	Pouilly cement .	23′ in the air	20.25	35	Left in the air.
2	do. restored on a plate of sheet iron .	5′	3.46	34	Immersed.
3	do. do. in a crucible	11′	4.23	34	do.
4	do. do. by supercalcination .	5′	11.53	26	Left in the air.
5	English cement deteriorated	21 hours	3.27	35	Immersed.
6	do. restored on a plate of sheet iron .	31′	4.32	35	do.
7	do. do. in a crucible . .	14′ in the air	15.75	35	Left in the air.
8	do. . .	14′ in the water	7.22	35	Immersed.
9	Mortar restored by supercalcination .	4 hours	3.60	26	do.
10	do. more highly calcined	6′ in the air	4.26	26	do.
11	do. . .	8′	15.26	26	Left in the air.

§22. *Influence of the age of Mortars.*

The two tables we have given of experiments, show a notable difference between mortar immersed and mortar exposed to the air—unfavourable to the former in all cases but No. 13 of the first table. They also show differences between the specimens immersed, which, judging from the time required to harden, were equal in quality. Has the age of the mortar an influence on these results? This we were desirous of ascertaining, at least in part, by some trials which are given in the following table.

Table LI.

No.	Substances employed.	Time required to harden.	Age of the mortar at the first trial.	Resistance to rupture per 0.394 inch (centimetre) square.	Age of the mortar at the second trial.		Resistance to rupture per 0.394 inch (centimetre) square.
			ds.	lbs.	mos.	ds.	lbs.
1	Pouilly cement with one half volume of water. . .	46′	22	7.35	1	19	8.01
2	do. .	46	27	9.72	4	11	14.36
3	do. . .	51	34	17.70	1	19	16.92
4	do. .	42	42	14.64	4	11	14.71
5	do. . .	52	49	13.03	4	11	24.11
6	do. .	54	51	15.29	4	11	19.59
7	do. . .	47	60	19.11	4	11	19.76

All these specimens were made, the same day, with cement from the same barrel, tempered with an equal quantity of water, and immersed immediately after the instant of setting in the air; they were all of the size of a common brick. Notwithstanding these similar circumstances, the mortars did not comport in the same manner; and they converged more or less ra-

pidly to the resistance they would have acquired at some future period, as, for example, at the end of one or two years.

§23. *On the mixture of sand and puzzolana with plastic cements.*

Thus far we have employed pure cement, in order to avoid bringing in new cases of irregularity; but it is not less necessary to know to what extent the substances will support a mixture of sands or puzzolanas: and consequently, to know whether it be possible so to add these substances as to have mortars equally good and more economical. With these objects we prepared several specimens which were submitted to rupture after about fifty-four days. This, as has been said above, is no doubt too short a time: but the numbers obtained agree in demonstrating that though sands and puzzolanas, in no way augment the quality of cement-mortars, they may be used without detriment in small proportion; as may be judged by the following table.

Table LII.

Substances employed.		Time required to harden	Age of the mortar at time of trial	Resistances to rupture.
		min.	days.	lbs.
One of Pouilly cement with	one-half of quartzose sand	48	54	14.64
do.	one-half of gneiss sand	43	do.	17.57
do.	one-half of coarse quartzose sand	60	do.	12.31
do.	one-half of Italian puzzolana in gravel	58	do.	14.55
do.	one-half of quartzose sand	44	do.	11.36
do.	one-half of do. and one-half of puzzolana.	57	do.	13.04
do.	one of gneiss sand	47	do.	13.58
do.	one of coarse quartzose sand	1 h. 2 m	do.	9.89
do.	one of puzzolana sifted very fine	49	do.	14.74
do.	one and a half of quartzose sand	47	do.	8.29
do.	one and a half of gneiss sand	1h. 7m.	do.	7.61
do.	two of quartzose sand	1h. 18m.	do.	5.86

As to the ability of these cements to resist frost we have no precise information to impart. We can only say that we applied the process of Mr. Biard to a specimen of pure Pouilly cement which had hardened in the air and was five months old. It deteriorated sensibly from the beginning of the experiment; and at the end of the seventh day we found 1.43 gr. loss from the original weight of 210 grs. Several kinds of bricks tried at the same time, as well as a specimen of mortar made of puzzolana from Italy, did not lose, by a great deal, as large a proportion of their substance. It is to be feared, therefore, that mortar of the Pouilly cement is not frost proof: and this will become a great objection, if, as has been proposed, this cement is used in making casts of moulded objects, statues, bas-reliefs, vases, &c., to be exposed to the ordinary inclemencies of the weather.

§24. *Classification of plastic cements with respect to limes and to puzzolanas.*

As we said in the beginning of this article, the limestones that afford plastic-cements contain a large proportion of clay: larger than hydraulic limestones, and less than calcareous puzzolanas. Establishing then the continued series of combinations which may be formed of pure lime and pure clay, we shall be led, as in the following classification, to three distinct products.

Table LIII.

Lime.	Clay.	Resulting products.	Distinctive characters of the products.
100	0	Very fat lime	Incapable of hardening in water.
90	10	Lime a little hydraulic	Will slake, when properly calcined, like pure lime—and will besides harden alone under water.
80	20	do. quite hydraulic	
70	30	do. do.	
60	40	Plastic cement	Will not slake with any degree of calcination—and will harden alone under water.
50	50	do.	
40	60	do.	
30	70	Calcareous puzzolana according to Mr. Bruyére	Will not harden under water without the addition of fat lime or of hydraulic lime.
20	80	do.	
10	90	do.	
0	100	Puzzolana of pure clay	The same.

The distinctive characters given in the table, show, as the proportions vary, the effects of a predominance of lime or clay. But the plastic cements have two maxima of energy, one at the point of incomplete calcination, and the other at the point of supercalcination: do they enjoy this singular property, exclusively? It is important to ascertain this.

1st. Pure lime stone incompletely calcined, slakes with difficulty, and even requires to be pulverised like plastic cement. According to Mr. Minard, if it be tempered with water and immersed, it comports in the beginning like a very energetic substance; and after four days, according to Mr. Vicat, it is impossible to make an impression with the finger. But beyond this, the solidification does not advance.

On the other hand Hassenfratz (at page 203 of his *Traité des mortiers*) says he has noticed that the fat lime of Moustier, supercalcined, gives, after being pulverised and tempered, a mortar which *sets strongly in water*. Mr. Vicat, also, announced in 1818 that common fat lime supercalcined, in contact with a mixture of charcoal and seacoal, became incapable of slaking, and gave, on pulverizing and moistening it, *a paste which hardened under water.*

It is hardly necessary to say that at the term of complete calcination, fat limes are entirely incapable of acquiring, alone, under water, any consistency. However feeble, therefore, may be the hydraulic property of fat lime at the points of incomplete and supercalcination, it is not the less true that it does exist, as in plastic cements.

2nd. Before Mr. Lacordaire had engaged in the Pouilly enterprise described §12, he had ascertained that a limestone but little hydraulic, from which all the carbonic acid had not been expelled by calcination, afforded a true cement; and he applied this observation to profit, in the works of the canal *de Bourgogne*, which he had in charge. With this view he used the ordinary kilns of the country, reducing to three days, the burning which

was commonly extended to six or eight days: he afterwards slaked the lime by immersion, separating the subcarbonated portions, which he incorporated in the mortar, after having reduced them mechanically to powder.

We were of opinion that the common limestone of Pouilly, alternating with the variegated marles, contained, like the marles, the claystone (septaria) of which Parker's cement is made, and that if Mr. Lacordaire preferred extracting these materials by subterranean galleries, rather than by open quarries, it was, no doubt, because he found, below, richer deposits and a better choice of materials. But one of our friends, Mr. Avril, an Engineer, to whom we had communicated our researches, profited by his being at Pouilly to examine this point with much care. He has announced that, in fact, the common limestone of Pouilly properly treated, and retaining about fifteen per cent. of carbonic acid, sets under water in five minutes, and does not yield in any thing to plastic cements; that therefore, the preference accorded to septaria, could not be explained except on the supposition that it was easier, with it, to secure the degree of calcination necessary, and because the limits of greatest energy were more extended. He also discovered that the hydraulic limestone of Pouilly, *suitably supercalcined*, enjoyed the same properties as when in the state of subcarbonate.

Some direct experiments on a few fragments of a hydraulic lime stone from Pompean, *(Ille-et-Vilaine,)* and from Doué *(Maine-et-Loire,)* lead us to believe that these properties are common to all limestones of analogous composition.

3rd. The good puzzolanas produced, on the one hand, by a torrefaction of some minutes on plates of iron, and on the other, by ochreous and refractory bricks, well burned, seem at first to establish two maxima of energy for clays also; but the experiments of the 17th article, (§6 and §7) demonstrated that these two degrees of heat are in fact but one and the same, and that these substances become so much the more inert as the term of vitrification is approached.

As to clays containing at least a tenth of lime, they require, according to M. Treussart, that the degree of calcination should correspond with that of a slightly burned brick; beyond which they become of a quality more and more deteriorated. Is it still the same, at the transition from puzzolanas to plastic cements, when the proportion of lime is from twenty to thirty per cent.? We are unable to say. But it is possible that the influence of lime is then prominent enough to give rise to two maxima of energy.

§25. *Geometrical representation of the influence of Heat on the several compounds of Lime and Clay.*

In order the better to exhibit the influence of heat on the several compounds of clay and lime, we will attempt to represent it geometrically. To do so, let us conceive that from a fixed point two lines are drawn at right angles to each other, of which the horizontal one shall be taken as the axis of the abscissas, and the vertical one, the axis of the ordinates. Then suppose that on the axis of the abscissas we take, from the point of intersection, lengths proportionate to some of the principal degrees of torrefaction; that, for example, we choose for the first the degree of moderate burning of bricks; for the second, the degree of thorough burning of bricks; for the third, the degree of complete calcination of fat lime; and lastly, for the

§26. *Influence of spontaneous slaking on Lime in general.*

As lime is not always used immediately on leaving the kiln, it is important to know what modifications time will bring about in its proper-

ties; and what precautions are necessary for its preservation, or in its use, after it may have become deteriorated.

When quick lime is abandoned to the contact of air, it absorbs moisture and carbonic acid from the atmosphere, and a certain quantity of oxygen also, according to Gen. Treussart. At the same time it splits and falls to powder; this being what is called *spontaneous slaking*, or *air slaking*.

For a long time it was thought that lime thus slaked was good for nothing; but this was improperly generalizing a consequence which is true only with one particular kind of lime. In fact, M. Vicat has ascertained, 1st, that fat limes do not deteriorate, and that they even give superior results to those obtained by slaking in the ordinary mode of immersion: 2d, that for hydraulic limes, on the contrary, spontaneous slaking is the more disadvantageous as the energy of the lime is originally the greater.

We owe to Gen. Treussart the proof of this last observation; obtained while he was in search of the relation between the degrees of alteration in the air; and time of exposure to the air. The following are some of his results.

Table No. LIV.

	Made immediately.	After 15 days.	After 1 month.	After 2 months.	After 3 months.
	lbs.	lbs.	lbs.	lbs.	lbs.
Obernai hydraulic lime with two parts of sand	121	77	44	33	<22

These specimens were all kept under water. We see, therefore, that all delay in the use of hydraulic lime tends to convert it into common lime, and that in large works a circumstance of this kind might be of serious consequence.

§ 27. *On the manner of preserving Hydraulic Limes.*

In the deterioration of hydraulic limes it is necessary to consider the influence of the water applied in slaking, and the influence of the contact of air. While the quantity of water absorbed does not exceed a quarter of the weight of lime, this last will remain in dry powder; it cannot solidify; and experience demonstrates that it may then be preserved without change, provided it be carefully covered from the contact of the air, in very tight barrels for example, like plastic cement. But if this powder, which is easily obtained by immersing the lime for twenty or thirty seconds in water, is exposed to the air, it comports nearly as in the case of air slaking; it becomes common lime. At works where there must be large supplies, it is hardly possible, however, to put the lime in casks, because they would be expensive from their number, and embarrassing from their bulk. A middle course remains, which consists in storing the quick lime in very close sheds, and enveloping it, on all sides, with a layer of lime already reduced to powder, in any way: an obstacle will thus be opposed to the circulation of air, and the interior parts of the mass will be preserved from its influence.

If this process is not perfect, it is at least economical: and although all the layers of powder which serve as an envelope will be unfit to be used

as hydraulic lime, it still may be used in a way that will soon be pointed out.

§ 28. *On the use of Puzzolanas in correcting the deterioration of Hydraulic Lime.*

In order to cause fat lime to harden under water, it is mixed with puzzolana; but deteriorated hydraulic limes, as we have said, act like fat lime: if this assimilation be exact, then the same process ought to be applied to both. This is, in fact, what happens; and it is observed that the amount of alteration has no sensible influence on the hardness acquired after about one year. Gen. Treussart was the first who insisted on this important fact; the following are some of his experiments.

Table No. LV.

	Made immediately.	After 1 month.	After 2 months.	After 3 months.	After 4 months.
	lbs.	lbs.	lbs.	lbs.	lbs.
Obernai hydraulic lime slaked spontaneously and mixed with one of sand and one of trass	209	389	352	308	495

Table No. LVI.

	Made immediately.	After 15 days.	After 25 days.	After 35 days.	After 45 days.	After 2 months.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Obernai hydraulic lime slaked by immersion and mixed with one of sand and one of trass	493	330	297	286	304	399

Hydraulic limes employed while fresh, will, according to M. Vicat, support puzzolanas the more advantageously, as the limes are the less energetic; and on the other hand, they deteriorate so much the more rapidly as they are the more energetic: we may thence conclude that if a hydraulic lime has been exposed to any cause of deterioration, it is prudent to mix with it, a certain dose of puzzolana, without any regard to its primitive degree of energy. Artificial hydraulic limes should be treated in the same way.

§ 29. *On the preservation of Puzzolanas.*

As to factitious puzzolanas, it may readily be conceived that their preservation requires but little care, for we know that from their situation in nature, the natural puzzolanas are exposed to all the vicissitudes of the seasons without any apparent loss of energy after a great lapse of time. We will say, however, that a newly made and perfectly dry puzzolana, from its possessing a higher degree of absorbent power, must have a favourable influence on the setting of the mortars. The mortars are often, in fact, tempered too soft; and, to lime already slaked to cream, the workmen add more water to lessen their labour; this excess of water being absorbed in part by the puzzolana, the mortar preserves a strong consistence, favourable to the reaction of its elements. In this respect it is therefore advantageous to keep the puzzolanas in dry situations, or at least if they have been moistened, to dry them in the air, or in the sun, before using them.

§ 30. *On the Solidification of Fat Lime.*

The preparation and the preservation of lime, puzzolana, and plastic cements, are connected so intimately with a knowledge of their properties, that we think it will be useful to add to the indications already given, some developments relative to the theory of mortars in general.*

Proceeding from the simple to the compound, let us explain what relates to common, or fat, lime. When it is plunged into water, it absorbs rapidly, and solidifies, a quantity of water equal nearly to 0.22 of its weight. Withdrawn, then, and left in contact with the air, it slakes with disengagement of heat, and is reduced to dry and impalpable powder. In this state it is capable of absorbing much water still, but without sensible disengagement of heat, and there results a paste more or less stiff. The first portions of the fluid, form, with the lime, a true chemical combination, known by the name of *hydrate of lime:* the other portions of water are, simply, *interposed.* Thus, lime in stiff paste will throw out, on working it, so much water that it is unnecessary to add more on making the mortar. The hydrate of lime, on the other hand, can only be decomposed at a high temperature.

This hydrate being a dry powder, its molecules are too far apart to be able mutually to approach each other, and to pass into the state of a compact mass; it is only after being brought to the state of paste that the hydrate is in a condition to be used. That being premised, it is well known that fat lime, if kept from contact with the air, may be preserved an indefinite time in paste; that this same lime at the ordinary temperature, or at a higher temperature, in paste, or dissolved in water, is without any chemical action on quartzose sand, whether the sand be in fine powder or not; that the mortars which result from the mixture of these two substances, remain soft, like lime alone, as has been ascertained by Dr. John, on examining thick masonry two hundred years old. But if the lime in paste, or the mortar, be left in contact with the air, it will solidify; and if the air be replaced by pure carbonic acid gas, the solidification will take place with great rapidity. In both these last cases the carbonic acid is absorbed by the lime, and this absorption will go on till the acid is to the base, in the ratio, approximately, of 43 to 57, as in the natural subcarbonate of lime. But it is worthy of remark that the proportion of water appropriated to the conversion of lime into a hydrate, is not rejected: the carbonate is not, therefore, *regenerated,* as before the calcination; and it is, in fact, a double salt, which might be called the *hydro-carbonate* of lime.

We see then that for the solidification of fat lime, 1st, the proportion of water must be greater than in the dry hydrate: 2d, there should be contact of the air, or, better still, of pure carbonic acid gas. 3d, the mixture of quartzose sand, without the contact of the air, would not have the least influence. Hence comes the superiority that lime slaked spontaneously, and consequently already somewhat carbonated, imparts to mortars. Hence also the impossibility that these mortars should harden under water, since water, in general, contains only inappreciable quantities of carbonic acid in solution.

The solidification, as Mr. Vicat remarks, spreads from the surface to-

*In a manuscript note communicated to M. Vicat early in 1826, and mentioned in his last work on mortars, we have already stated some of the propositions which follow.
AUTHOR.

wards the centre of the specimen: but the quantity of gas that can pass through the voids of mortar beyond a short distance, is too small for its direct influence to be sensible: if then, there is not a total cessation of absorption, it must be admitted that the transmission must go on by the play of affinities—by the tendency that the several concentric layers of lime have to an equilibrium of saturation, like the transmission of heat in solid bodies. It must also be admitted that the equilibrium is the more difficult to attain, as the parts requiring saturation are more remote from the surface, and the dose of acid already received, is the greater, so that the thickness of mortars is injurious to their solidification: that in equal times, the increase in hardness will be far from being equal, and will progressively become less and less, and, lastly, though it may be exact to say that mortars made of fat lime improve as they grow old, still the improvement may not be at all sensible at the expiration of periods of only a few years each.

§ 31. *On the distinctive characters of Meagre lime and Hydraulic lime.*

Natural limestones often contain earthy or metallic oxides, which by calcination combine with the lime. Whence result modifications in its properties. Thus it is known that lime will remain a fat lime so long as the foreign substances do not form a tenth of its weight; but beyond that it becomes meagre, that is to say, it swells much less on slaking; and, if amongst these foreign bodies, silex should predominate, the paste, with, or without, sand, will acquire the property of hardening in water. It was for a long time thought that other foreign bodies acted like silex; but the method of investigation followed by Mr. Berthier, leaves no doubt in this respect. We will give a summary of his results.

Comparing, first, the quality of various limes with their chemical composition, Mr. Berthier found:

Fat lime from Chateau-Landon to contain 96.4 pure lime—1.80 of magnesia—1.80 of clay (silex and alumine.)

Meagre lime from Coulommiers 78.00 pure lime—20.00 of magnesia—2.00 of clay (silex and alumine.)

Lime moderately hydraulic from Saint-Germain—89.00 of pure lime—1.00 of magnesia—10.00 of clay (silex and alumine.)

Lime very hydraulic from Senonches—70.00 of pure lime—1.00 of magnesia—29.00 of silex. To these analyses we will add:

Meagre lime of Brest—82.30 of lime—10.00 of oxide of iron—7.70 of clay.

We see from these analyses that silex, whether pure or mixed with alumine, renders lime hydraulic; and that magnesia, or the oxide of iron, renders it meagre and not hydraulic. Mr. Berthier found the same consequences when proceeding synthetically: he ascertained that silex in jelly, calcined with pure lime, gave an hydraulic product; that alumine, magnesia, oxide of iron, and oxide of manganese, calcined, one by one, with pure lime, gave a meagre lime only: that alumine or magnesia mixed with silex increased the hydraulic property, and, lastly, that the proportions the most favourable for the mixture were equal parts of silex on the one hand and alumine or magnesia on the other.

A consequence results from these considerations which it is important to mention: it is this, that the process of Mr. Vicat for preparing artificial hydraulic lime, does not answer equally well on taking any limestone or clay that may present itself: that it is, with difficulty, applicable to mea-

gre limes mixed with ochreous clays, and that this is the case at Brest, where, the matters being charged with oxide of iron, nothing passable was obtained, and we were obliged to resort to puzzolanas.

§ 32. *On the solidification of hydraulic lime.*

Hydraulic lime slaked in the ordinary manner solidifies a certain quantity of water as fat lime does; and forms, with an excess of water, a paste, more or less stiff. If left exposed to the air, it absorbs less carbonic acid than fat lime; and, like fat lime, it retains the water it had solidified.

According to Mr. Vicat there are in 100 parts of fat lime = 100.00

Absorbed carbonic acid	76.00
Retained water	17.00

And in 100 parts of hydraulic lime which contains a fifth of its weight of clay:

Absorbed carbonic acid	54.00
Retained water	15.00

But this last result may be put under the following form:

Pure lime	100.00
Clay	25.00
Carbonic acid	67.50
Water	18.70

It differs therefore, in this respect, very little from fat lime, so that it is equally a *hydro-carbonate* of lime, the clay appearing not to enter into the combination.

On the other hand, when the paste remains immersed in water, the aid of the carbonic acid is no longer possible, and that of the silex becomes indispensible to solidification. It remains to seek the cause of this phenomenon.

1st. Pure lime is soluble in five or six hundred times its weight of water, and the product is called *lime water*.

2nd. Pure lime combined by calcination with gelatinous silex is only partially soluble in water, and leaves a residue, composed of sixty-five parts of silex and thirty-five parts of lime, which is known under the name of *neutral silicate of lime*.

3rd. Pure lime combined in the same manner with alumine, magnesia, oxide of iron, or oxide of manganese, although it has lost the property of swelling much, or slaking, is still soluble in water, and the residue contains nothing but pure alumine, or magnesia, or the oxide of iron or manganese.

4th. In order that a lime may be hydraulic, it will suffice that it possesses six or seven per cent. of silex, a quantity that can render only a very small dose of lime insoluble.

5th. Plastic cements, at the point of complete calcination, may be assimilated to ordinary lime—they are but slightly hydraulic, although they contain a considerable portion of silex.

We see then that the combination of silex with lime has, alone, the advantage of resisting the attacks of water: that if alumine and some other oxides raise the hydraulic energies, it arises probably from this, that the obstacle they interpose to the swelling of the lime tends to the concentration of the molecules, thereby helping their predisposition to submit to the influence of the silicate of lime: and that free lime, notwithstanding its solubility, ought always to predominate in the immersed paste.

The question being thus stated, it is necessary to explain two effects; the insolubility, and the hardness, acquired by mortars under water.

In the first place, it cannot be admitted that the silicate of lime solidifies separately, and that it envelopes the hydrate as a gangue; for the last would not be less soluble, and the hardness acquired would be proportionate to the quantity of silicate, which, in general, is not true. Every thing leads to the opinion rather, that the molecules of silicate are so many centres of attraction, with respect to the soluble molecules, and that, within the sphere of activity of each of these centres, there is an arrangement which may be assimilated to a true *crystallization*.

On this hypothesis, we conceive, the most proper proportion of silicate, is that which leaves around each molecule thereof, a layer of hydrate equal in thickness to the radius of the sphere of attraction: that below this term, that is to say, in measure as the silicate becomes more abundant, the layers of interposed hydrate are submitted to attractions which interfere with and disturb, instead of mutually aiding, each other, that above this term, that is to say when the silicate is in too small a quantity, the layers of hydrate may still solidify, not so soon, nor wholly by the direct action of the silicate, but by the influence of the particles nearest the silicate, which, in measure as they solidify, react in their turn upon others: as in saline solutions, a crystal already formed may be the proximate cause of crystallization.

It may in the same manner, be conceived that hydraulic mortars have need of moisture rather than dryness, because the water preserving to the molecules a certain mobility, permits their arranging themselves in juxtaposition by the proper facets. It must not however be concluded that soft mortars would be preferable to mortars in stiff paste: because the water augmenting too much the distance of the molecules, would throw them beyond the sphere of mutual attraction: hence one of the causes why hydraulic mortars are generally less hard on the surface than in their central parts, while it is the reverse with all mortars made of fat lime and hardened in the air.

§ 33. *On the influence of the dissolving action of water.*

This fact has relation to another cause on which it is important to insist.

When hydraulic mortar is immersed in the bottom of any vessel, two opposite molecular forces are set in action: on the one hand, the action of the silicate of lime on the hydrate, and on the other, the solvent force of the water with respect to this same hydrate. The water being supposed tranquil, the lower portions of it dissolve the lime: but as this water becomes more dense it remains at the bottom, without power of removal; and the lime thus dissolved cannot be transferred to the upper portions of fluid except by the play of affinities—by a transmission analogous to that of carbonic acid in the interior of mortars made of fat lime. However that may be, the portion of water in immediate contact with the mortar losing its solvent power in proportion as it approaches the term of saturation, an equilibrium will soon be established between the two opposite molecular forces, and then all solution will cease. But if the superficial layer of mortar has lost a small portion only of its hydrate, this equilibrium, will, as regards the progress of solidification of the mortar, be only instanta-

neous: this layer might in fact continue to take cohesion from the influence of the under layers of mortar not attacked by the water.

If, on the other hand, the liquid be agitated, in order to render the saturation uniform throughout the mass of fluid—or rather, if the mortar be immersed in running water, it may happen that the exterior layers of mortar will, little by little, lose all, or the greater part, of their hydrate; but this effect not being brought about instantly, the interior layers would be protected for a time sufficient for them to harden beyond its solvent power before becoming, in their turn, exposed to the action of the water. We can conceive, therefore, that mortars may wash away for a certain depth: and that thickness may be an indispensable condition to the success of the solidifying process.

§ 34. *Influence of Quartzose Sands.*

As the practice is to use hydraulic limes, not pure, but mixed with sands, it is important to study the influence of these sands on the induration of mortars. We shall speak here only of quartzose sands, which are the most common.

It is demonstrated by experiments that caustic lime, cold or hot, is without any action on quartz in discernible particles: if, then, it adds to the quality of hydraulic mortars, it can only be because, 1st. it augments the density of the mass, and thus prevents its being brought to the state of soft mortar by being too easily permeable to water: or, 2nd. because its adherence to the lime, however feeble it may be supposed to be in the first instance, is an accelerating cause of crystallization. That this should be so, it is not necessary to suppose that the sand exercises a chemical action on the lime: because we know, for example, that in the preparation of rock-candy, and of verdigris or acetate of copper, &c. it is only necessary to stretch threads, or place sticks of wood, in the solutions, to determine the crystals to group around them like clusters of grapes, while none show themselves any where else. Sands in this, do no more than aid the tendency of hydraulic limes to take cohesion; and their influence is null when this tendency does not exist, as for example in fat lime. If the experiments with this last lime be attentively examined, it will be seen that they harden better alone than when mixed with sand: that the particles of hydro-carbonate have greater cohesion amongst themselves than adhesion to sand; whence it naturally follows that sands which divide the mass most thoroughly, that is to say, the finest sands, are the worst, because in an equal section the extent of surfaces in contact is the greatest. The contrary takes place in hydraulic limes, according to Mr. Vicat. If some experiments of General Treussart do not accord with these ideas, it seems to be owing to the too great quantity of sand used in his mortars.

§ 35. *On the solidification of deteriorated hydraulic limes.*

We have seen, at the commencement of this article, that hydraulic limes slaked spontaneously in the air, and not used for some time, lost their energy, more and more. We will add an analogous fact that we have had occasion to observe; it is that the hydraulic lime of Doué preserved for two years in flagons, well stoppered, so as to prevent any change of air, or the absorption of humidity, remained in fragments it is true; but these fragments had lost the power of slaking, and also of setting under water, after

having been tempered like plaster. What has occurred in this case? This we have to explain.

It is well known that the limestone affording hydraulic lime, when treated, before calcination, with muriatic acid, leaves generally an insoluble residue composed of silex and alumine; but that immediately after calcination, the same stone, now become quick lime, is completely soluble, which shows the existence of a chemical combination: this being premised—we have taken hydraulic lime which had been slaked in air for two months; treated it with muriatic acid in excess, and it gave a considerable gelatinous residue: we have treated hydraulic lime preserved for two years in the same way, and the gelatinous residue was so abundant that we were forced to believe there could be no silex dissolved with the lime. But however that might be, is it not evident that the silicate of lime is decomposed, at least in part? that, therefore, in the case of the deterioration of hydraulic limes, the silex having taken cohesion, is only to be considered as being mixed intimately with the lime, and consequently can do no more than perform the office of puzzolana mixed in small doses with fat lime. Hence the great inferiority of the results, and the necessity of remedying them by the method of General Treussart.

§ 36. *On the solidification of Puzzolana Mortars.*

Let us pass now to the case of puzzolana mortars. According to what has been said before, an indispensable condition to the solidification of lime under water, is, that a small portion of this same lime be first rendered insoluble—each of the insoluble particles becoming the centre of attraction with respect to the surrounding layers of hydrate. Is this condition fulfilled on mixing fat lime with puzzolana? This is put beyond doubt by Mr. Vicat showing that puzzolanas have the property of precipitating lime from its solution in water, and that their energy is proportionate to the quantity of lime water they can thus precipitate. Whatever may be the cause of this property, whether it does, or does not, belong to a chemical combination between the lime and puzzolana—a combination difficult to conceive on account of the state of cohesion of the silex—a cohesion assuredly much greater than in deteriorated hydraulic lime, it is not less true that this fact suffices to establish a satisfactory analogy between the solidification of puzzolana mortars, and those made of hydraulic lime. It may be inferred from thence that the mixture of puzzolana with slightly hydraulic lime will give good results, because in such limes the proportion of hydrate would not be superabundant; with limes very hydraulic, it may be inferred, on the contrary, that this mixture would become injurious, because the proportion of lime would be too small, and there would result a kind of plastic cement, at the term of complete calcination.

The puzzolanas are mixed like sands, in the proportion of one and a half to two and a half in volume, to one of lime in paste. This proportion supposes, no doubt, much more silex, than is required to constitute hydraulic limes; but it must be remarked that in these limes, all the particles act in the most favourable circumstances possible, while in the above mixtures, they are collected in grains of some size, acting only by their surfaces, and their action being weakened by the cohesion that they already possess in a high degree.

§ 37. *On the solidification of Plastic Cements.*

Let us, in the last place, see to what degree the principles previously admitted will serve to explain the solidification of plastic cements, in the most general case; that is to say, as was explained at the end of article XVIII, section 25.

1st. In fat limes imperfectly calcined or super-calcined, the particles carbonated or super-calcined, requiring to be worked to make a paste with water, and being convertible into hydrate only with difficulty, it may be conceived to be not impossible that they play the same part as lime rendered insoluble by silex or by puzzolana, and that thus the commencement of hydraulic quality is obtained.

2d. In hydraulic limes imperfectly calcined, the particles of carbonate act in the same manner, but with this advantage that their influence on the solidification is increased by that of the silicate of lime which is present.

In the same lime stones carried to the second maximum of energy, the particles of carbonate are replaced by the equally insoluble super-calcined particles.

3d. In the septaria furnishing the ordinary plastic cement, the clay is too abundant to leave, at the term of complete calcination, the proportion of hydrate of lime necessary to a good solidification: the imperfect calcination, then, has for object to render the silex only partially soluble in acids so that it may the more resemble the mode of action of puzzolanas.

Lastly, at the term of super-calcination, the clay of these same lime stones passes to a state of less energetic puzzolana than at the term of complete calcination, and thereby leaves a greater proportion of lime susceptible of conversion into hydrate.

The developments into which we have entered relative to the solidification of mortars in general, are far, no doubt, from exhausting the subject; and require to be sustained by numerous experiments. We are fully aware of this; but our object not being to present a treatise on mortars, we have restricted ourselves to so much as is useful in understanding the operations of lime burning, which we have described.

[TO BE CONTINUED.]

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JULY, 1837.

With Remarks and Exemplifications by the Editor.

(CONTINUED FROM P. 274.)

196. For a machine for *Reducing Thread Waste into Wool;* William Gray, Hebron, Tolland county, Connecticut, July 29.

Although this machine is for the same purpose as that noticed at No. 170 for the same month, it is not the same in construction. By referring to No. 170 it will be seen that the separating the waste thread into its original fibrous state is to be accomplished by it, principally, by beating against slats, or knives. In the present machine the reducing is principally effected by the operation of rollers set with points, between which it is passed. The claim made is to the reducing by "passing it successively between feeding rollers on to reducing rollers, whence it is delivered on to endless aprons,

and pressed by pressing rollers, preparatory to its being again acted upon by reducing rollers." The pressing rollers upon the endless apron press the partially reduced thread into a bat, preparatory to its being again acted upon by reducing rollers.

197. For improvements in *Cooking Stoves;* Edwin Reed, West Bridgewater, Plymouth county, Massachusetts, July 29.

The claim made in this stove is to the particular arrangement of the dampers, so as to govern and direct the fire; to certain peculiarities in the construction and direction of the flues, and to the thereby heating those parts effectually which most require it. There is more novelty in this than in the greater number of stoves offered for patents, and we doubt not that it will operate well, and from good materials prepare a good meal.

198. For an improvement in the manner of constructing *Ovens for Stoves;* David W. Barker, Clyde, Wayne county, New York, July 29.

This oven stands above the stove, like a closet, or book case. It has shelves upon which to place the viands, and doors which open on the front and back. The ends and top are double, forming flues from the stove below it to the pipe which rises from the centre of the top, there being valves to govern the draught. The claim to the "oven is the particular manner in which it is connected to and combined with, the fire place, or stove; that is to say, standing above and behind the fire chamber, with a flue leading therefrom under it, and up at each end only of the oven, which oven has doors at back and front, in the way described."

199. For improvements in the framing of *Locomotive Steam Engines;* Ross Winans, Baltimore, July 29.

This patent is taken for a particular manner of framing the carriage part of the locomotive, and of covering the sides of the framing with continuous sheets of iron, and is particularly adapted to the kind of engine built by Mr. Winans.

200. For an improved *Coal Cooking Stove;* William Kenney, Louisville, Jefferson county, Kentucky, July 29.

We can only again repeat as regards this stove, what we have said respecting many others, that the claims are founded on the manner of directing the flues, and of governing the passage through them by means of valves differently situated. It will readily be believed that the differences are in many cases very trifling, consisting sometimes of little more than a change of shape, which although it may not be calculated to make any material change in the action of the apparatus, will be considered by the *inventor*, as a thing of primary importance, the denial of a patent for which would be an outrage upon genius, deprive him of fortune, and the public of the benefits of a magnificent discovery, unless he should give it as a free will offering.

201. For an improvement in the *Apparatus for blowing the fire in Locomotive Steam Engines;* Ross Winans, Baltimore, July 29.

In the engines used on the Baltimore and Ohio railroad, anthracite has been generally used as a fuel, and some of these engines have been put upon

other roads. Where this fuel is employed it has been found necessary to quicken the combustion by a blowing apparatus, and this patent is taken for an improvement upon such an apparatus formerly used.

The improvements claimed are "first, the varying, increasing, and regulating, the blast created by the fan wheel, by contracting or enlarging the passage, or aperture, through which the steam issues on to the fan wheel, substantially in the manner and for the purpose described. Secondly, the placing of the steam and fan wheels upon an upright shaft, and the arrangement of the different parts in conformity therewith, which enables me to combine the steam and fan wheels in a convenient and compact form for the use of locomotive engines."

The fan wheel is driven by the action of the waste steam, as in the engines of the late Phineas Davis, whose patent is now the property of Mr. Winans.

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202. For improvements in *Locomotive Steam Engines;* Ross Winans, Baltimore, July 29.

This patent is taken for the manner in which the patentee has combined a vertical boiler with cylinders placed horizontally; and for the manner in which he has combined these with a spur and pinion wheel shaft, which operates upon the road wheels. There is much skill displayed in the mode of arrangement and combination, which are made clear by the drawings appended to the specification, and which cannot be understood without them.

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203. For an improved *Cooking Stove;* James Richardson, Poultney, Rutland county, Vermont, July 29.

This is a square stove, with a fire place resembling that in Stanley's rotary. The top plate also has projecting rims connected together by semicircular flues, as in the top of Stanley's stove. Behind the fire there is an oven, under which there is a flue, for the passage of heated air. The patentee states that "The novelties in this stove are, *First,* That the fire and heated air may be driven downwards through the openings in the grate, under and past the oven, while the grate and fuel are placed at different heights above the top part of the flue, under the oven, and at a higher elevation than the oven bottom. *Second,* In the oven there is a horizontal plate, covering the whole size of the oven at the bottom, and resting about one inch above it. This plate has several oblong or tapering holes or apertures therein, which are from one to nine inches in length, and one inch wide at the widest part. These holes or apertures commence near the back and cooler parts of the oven plate, and run towards the front part of the oven, diminishing in length as they approach the centre of the plate. This plate is called the upper, or movable, oven plate. The object of the last described plate, with apertures therein, is to assist in equalizing the heat in the oven, by discharging the heat which is created in the under oven bottom through these holes, to the back, or cooler part of the oven." The claims made are in accordance with the foregoing statements.

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204. For improvements in *Locomotive Steam Engines,* by which they are adapted to undulating and curved roads; Ross Winans, Baltimore, July 29.

The claim under this patent will afford a good general idea of the princi-

ple of regulation, and of the mode of procedure by which this principle is to be carried into effect.

"What I claim as new in the foregoing specification, and for which I ask an exclusive privilege is:

"*First.* The connexion of the power to four or more wheels, and the use of much larger cylinders than usual, in proportion to the weight of the engine, expressly with a view to, and in combination with, the cutting off the steam at different portions of the stroke of the piston, by means of which arrangement and combination, the object before stated, of adapting locomotive engines more perfectly to undulating and curved roads, to heavy and light loads, and to slow and fast speed, than heretofore has been effected.

"*Second.* The use of two, or more, arms operating on the slide valves, admitting the steam immediately to the cylinders, for the purpose of cutting off the steam at different portions of the stroke of the piston, as before described, thereby economising the steam, and consequently the fuel, and better adapting the engine to the duty it may have to perform, with different loads, and on varying grades of the road. The use of several cams, or of one cam so constructed as to perform the office of several, as herein-before described, I believe to be new in itself, separate and apart from the combination herein claimed, and applicable to every species of locomotive engine with advantage, and, as such, I claim a patent for it. The cutting off the steam at a portion of the stroke by a cam operating on the slide valve, has been long known and used on locomotives and engines; but the change in the time of cutting off the steam, as described herein, and thus being able to work the engine at full, half, or other, stroke, at pleasure, while the engine is in motion, has not before been done by a cam, or cams, operating on the same valve. An arrangement has been used for cutting off the steam at some one portion of the stroke, and changing from that to full stroke, at pleasure, while the engine was in motion, similar to that practiced in most of the steamboats of the present day, by having a throttle, or separate valve, moved by a cam, or eccentric, or crank, and so arranged as to cut off the steam at a portion of the stroke when desired. This, however, does not interfere with either of my claims, inasmuch as my *second* claim is for a mode of effecting the cut off by means of the same valve that admits the steam to the cylinder, and without a separate valve; neither does it interfere with my *first* claim, inasmuch as the cutting off the steam, and working at full stroke, at pleasure, has not been done in combination with the arrangement of connected wheels and large cylinders, as herein described—and which arrangement, in combination with the cutting off the steam, as herein described, is of the utmost importance in effecting the object of my invention, to wit, the adaptation of the locomotive engine to undulating and curved roads more perfectly than heretofore, or to roads where considerable variation in the power of the engine is required."

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205. For apparatus for *Heating Water for Steam Boilers*; Ross Winans, Baltimore, July 29. (See specification.)

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296. For an improved *Revolving and Sifting Grate*; Enos B. M. Hughes, City of New Haven, Connecticut, July 29.

This is a grate which may be set in an open fire place as a substitute for the ordinary grate for burning anthracite. It has flat ends, which may be

made oval, and between these ends there are bars which continue all round, those constituting the upper part being made to open for supplying fuel. The ends are each made of two cast iron plates, the innermost of which has a rim to contain a lining of fire brick; and from the outermost of each extends a gudgeon upon which the grate is supported, and upon which it is made to revolve, for the purpose of sifting out the ashes.

Claim. "What I claim as my invention, is a revolving grate, with non-conducting ends, and all sides formed with open bars, which grate confines the burning coal, and sifts and cleanses it from ashes, and other small incombustible particles. And I claim only what is necessary to the construction of a grate which combines non-conducting ends, all its sides formed with open bars, and a revolving motion, as described."

Grates suspended upon gudgeons, and having bars all round, are not new, and could not be claimed alone, and of this the patentee seems to be aware; the nonconducting ends, in a grate so suspended, is the only novelty, and this must be understood as the basis of the combination claimed.

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207. For an improved mode of fixing *Weather Strips to the Bottoms of Doors*; Isaac D. Brower, New York, July 29.

The weather strip used is a strip of metal let into a groove along the lower edge of the door, and closing, when down, against a rebate along the sill. The strip is attached, in the middle, to a sliding bolt enclosed within the framing of the door, and it is raised by the action of the knob which moves the spring-bolt of the lock, by attachments contained within the frame work. The closing of the strip is effected by a sliding rod which projects out from the hinged edge of the door, the pressure of which against the rebate in the door frame insures the descent of the bolt and the strip to which it is attached. The claim is to the arranging and combining the respective parts, so as to operate upon the weather strip, in the manner described.

The arrangement is made with much ingenuity, and we perceive but one difficulty in the way of its action; we feel assured that the appendages to the sliding bolt of the lock, by which the strip is to be raised, will cause the handle to turn with some difficulty. We apprehend, also, that the application will be too costly for general adoption.

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208. For *Paddles to be used as Ice Breakers and Propellers;* Washington Van Dusen, Kensington, Philadelphia county, Pennsylvania, July 29.

The paddles used in this boat are fixed upon jointed frames, which are actuated by crank motion, in such a way as to cause them to dip into, and leave the water nearly at right angles to its surface. The paddles are to rise entirely out of the water, and as they are to be used as ice breakers, they are to be made of iron and steel. The crank is of considerable length, say five feet, and the paddles, or breakers, are brought into contact with the ice when the crank is at its point of rapid descent.

The patentee notices the previous use of paddles operated by crank motion, and points out the difference in construction, and action, of those used by him. The claim is to "the method of operating the paddles, or ice breakers, by means of a crank at one end of a crank frame, having at the other end a vibrating frame, as set forth. Also, the employment of such a paddle frame lengthened out, and sliding back and forth, horizontally, be-

tween guides, whether used for breaking ice and propelling at the same time, or for propelling simply."

209. For *Bandages, Pads, &c., for Hernia, &c.;* Robert Thompson, M. D., Columbus, Franklin county, Ohio, July 29.

The patentee claims to have made improvements "in the mode of constructing bandages, pads, and other articles connected therewith, for the purpose of giving support to debilitated portions of the human system, and of effecting a cure, or producing relief, in cases of hernia, prolapsus, and other similar affections.

The instruments used are necessarily various in their construction, as they are to be applied to several different objects. The claims made are to "the employment of perinæal straps, in the manner set forth. The manner of making and adapting the abdominal bandage to the form, and to the support of the abdomen, by the employment of an elastic band of webbing along its lower edge, serving as a constrictor to it. The formation of a pad for hernia, by taking an impression of the part to which it is to be applied, for the purpose of procuring a pad possessing the exact form thus obtained, by casting, carving, or otherwise; and the mode of applying such a pad by confining it in its place under a bandage unattached thereto, or to any of the usual appendages of such pads. Also the employment of a spiral pad combined with the elastic strap proceeding from what I have denominated the abdominal portions, or bandage, and uncombined with a steel or other spring with which such pads have heretofore been connected, for the purpose of effecting a counter pressure, which makes no part of the object had in view by me in its employment. And, lastly, the use of a forked strap, having its hinder, or forked ends, attached to the back portion of the pelvic strap, giving support to the hips, as they proceed towards the pad from which they bifurcate."

But a very imperfect idea can be formed of the foregoing devices, without the drawings which accompany the specification. Some of the particulars named, are, however, sufficiently tangible, and as we believe, new. In the use of bandages we think that but little room is left for novelty of invention, and we believe that they rarely, therefore, afford sufficient ground for a claim under a patent; but when previous use of such as are identical with those claimed cannot be shown, the office grants a patent, and the risk of sustaining it is, of course, with the claimant.

210. For an improved *Rotary Steam Engine;* David Grannis and David E. Brand, Collins, Erie county, New York, July 29.

The claim under this patent is to "the manner of working the draw buckets by means of pins working in grooves, or upon guides made upon the inside of the heads of the cylinder." The machine belongs to that class in which there are two valves, "draw buckets," against which the steam is to act alternately as one cylinder revolves within another. The only novelty is in the mode of withdrawing the valves, by means of eccentric grooves; a thing which has been effected in various ways, some, of course, more simple, and so far better, than others, but the best of them not approaching a single step towards the removal of those deep seated objections which lie against all rotary steam engines, and in an especial manner against those in which there must be close fitting valves, to open and close in a revolving apparatus. We wish that we could bestow a word of praise

in the present case, but as we have no hope, we cannot attempt to inspire any.

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211. For a machine for *Dressing Sawed Shingles, &c.;* Geo. L. Day, Union, Browne county, New York, July 29.

The shingles are to be dressed by means of cutters upon a cutter wheel, much in the manner of those used in some planing machines. The principal novelty in this machine is the manner of arranging and governing the action of the feeding rollers, by which the shingles are guided, and the claim is to this peculiar arrangement.

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212. For a *Machine for Cutting Screws;* Joseph Blackhall, city of Albany, New York, July 29.

There is very little novelty in the *invention* which forms the subject of this patent. Three poppet heads, in a line with each other, are placed upon a suitable bed; through collars in two of these passes a shaft or mandril which has forceps at one end for gripping the piece which is to be cut by passing it between dies in the third head. The mandril is to be turned by a winch, or otherwise. Some of the things claimed are of doubtful originality, and we do not see any which render this machine superior to others that have been used for the same purpose.

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213. For improvements in the *Machinery for Breaking and Dressing Hemp and Flax;* Chapman Warner, A. T. Mixsell, and E. I. Horn, Belvidere, Warren county, New Jersey, July 31.

Claim. "What we claim as our invention is the manner of constructing the breaking apparatus as herein described, consisting of a vibrating frame of beaters, operating between two stationary frames adapted thereto, and having the hemp or flax fed in on each side of the vibrating frame, by the aid of clamps, carried forward by an endless chain or band. We claim also the manner of forming the dressing apparatus, with its knives affixed upon a hollow drum or cylinder, and having a fan wheel within it, operating in the manner and for the purpose set forth. We likewise claim the vibrating frame of the hatcheling apparatus, in combination with the cams, or guides, constructed substantially as herein fully made known."

It will be seen by the foregoing claims, that the construction of this machine cannot be readily given without the drawings. In its general operation it resembles some others, but there appear to be various provisions in most of its parts entitling it to the character of novelty. In an operation where so many machines have failed altogether, or but partially succeeded, we will not pretend to anticipate the fate of this; but in point of arrangement it has merit. The dressing apparatus spoken of "consists of a hollow drum, or cylinder, revolving horizontally, having dressing knives projecting from its periphery, and a fan or wind wheel within it, revolving in a direction the reverse of that of the drums, the wind from which passes out through mouths or openings in the periphery or drum, in the spaces between the dressing knives, the current of air passing out from the wind wheel opening the fibres, tending to keep them up against the dressing knives, and blowing out the shivers so as to separate them completely from the dressed hemp or flax."

214. For an improvement in the mode of *Printing and Drawing Checks to prevent Counterfeits;* John Dainty, Philadelphia, July 31.

This is one of those devices the ingenuity of which will not cause its adoption. One thing claimed is what the patentee calls a "safety bar," in which the amount is to be written in figures. A plan of combining figures and letters is also explained and claimed; also a particular mode of making entry in a register, or firm book.

If a person cannot find half a dozen merchants who will adopt a plan like the foregoing, if allowed to do so free of charge, the inference is a fair one that they will not pay for it for the sake of the parchment, the great seal, and the patent right.

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215. For a machine for *Turning Mouldings and Beads;* Eli Coddington, Thompson, Sullivan county, New York, July 31.

This machine appears to be principally intended for turning such articles as broom and brush handles, which are simple in their form. The stuff to be turned is fixed by one end in a chuck in a collar and mandril lathe, and a sliding head, furnished with suitable guide pieces, and cutters, is forced up against it; in this head there are cutters so formed as to cut beads, hollows, or other simple members of mouldings, which cutters may be brought down upon the stuff in the proper places. It is to this part that a claim is made.

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216. For an improvement in the *machine for bending the Tire of Wheels, and other articles;* Thomas C. Barton, New York, July 31.

The bending is to be effected by means of three rollers not differing materially from those frequently used for the purpose; but there is an adjustment of one of the rollers by the combined action of a frame, lever, and screw, which arrangement forms the subject matter of the claim.

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217. For a *machine for drilling the tire of wheels;* Thomas C. Barton, New York, July 31.

The drill is fixed in a mandril running in collars; the devices which form the subject of the patent, are for fixing and using the drill more conveniently than heretofore, when applied to the drilling of tire, and the claim is confined to this particular arrangement.

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218. For a *machine for Husking Corn;* Jonathan Cutler, Pickney, Windham county, Vermont, July 31.

Two iron rollers which may be thirty inches long, and an inch and a half in diameter, are fluted from end to end, and placed in a frame, where they are geared together, and made to revolve horizontally on suitable bearings, and nearly in contact with each other. The corn to be husked is fed down a wooden trough so as to fall between the rollers, the flutes of which seize the husk, and draw it off. The ears of corn are thus successively supplied, and pass off at the far end of the roller. The claim is to a machine constructed substantially in the manner of that described.

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219. For improvements on *Drawer, Commode, and Cupboard door knobs;* David Hoffman, city of Baltimore, July 31.

The specification is as follows. "The nature of my improvement con-

sists in inserting, or otherwise fastening, topically stained, painted, coloured, gilt, or silvered glass plates of various patterns and sizes, into stocks of wood, with either metal or wooden spindles; and for the purpose of variagating and increasing the brilliancy of the colours I place either coloured foil, coloured paper, coloured glass, coloured metals, or looking glass, underneath said plates according to the patterns required." The claim is to the knobs so made, as a whole; and if the whole of those made resemble the specimens deposited in the Patent Office, we apprehend that the patentee may not only claim, but actually keep the whole.

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220. For a new mode of constructing *Paddle Wheels for propelling Steam Boats;* William A. Douglass, Albany, New York, July 31.

By a particular arrangement of levers, joints, and slides, the buckets of the paddle wheel are to be made to enter and leave the water vertically, or at such angle as may be preferred. The same thing has been accomplished by other modes of construction, some of them less complex than that here proposed; so far, however, as the results of experience have been known, all devices of this kind have proved worse than useless, not in the slightest degree accelerating the speed of a boat, whilst they consume a part of the power of the engine, and are much more costly at first, as well as more liable to derangement, than wheels with the ordinary fixed paddle. The patentee claims the particular mode of construction invented by him.

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221. For a *Plough;* John Deats, Roxburg, Warren county, New Jersey, July 31.

The claims made in this plough, are to "the manner of forming the pattern of the mould board, so as to cast it to deliver from a single flask, with a tenon, or pin, cast near its front edge, in the manner, and for the purpose, described." There are also certain claims to the manner of constructing particular parts, as explained in the specification.

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222. For a new mode of *attaching Knives or Dirks to Pistols;* Robert W. Andrews, Stafford, Tolland county, Connecticut, July 31.

"The nature of my invention consists in so attaching a knife or dirk, to a pistol, or other small fire arm, as that the breech, with its lock, guard, and other fixtures, being separable from the barrel, shall serve as a convenient handle, or hilt to the knife, or dirk, making use of the blade as an essential means of connecting the breech, lock &c. with the barrel, to form the piece entire."

To the under side of the barrel, is attached, a sheath, or scabbard, which slides over the knife, or dirk, affixed to the stock, making, when in place, an entire pistol. The claim is to "attaching the scabbard to the barrel, and making it an essential part in holding the piece strongly and firmly together."

223. For improvements in the *machine for cleaning and dressing Feathers;* Samuel Sweet, jr.

There are two drums, or cylinders, one placed above the other, within a case, and an endless band or apron passes round these cylinders. The upper cylinder revolves on gudgeons, the lower lies in the apron, which it keeps stretched by its weight. The apron is set round with projecting points, the case being large enough to admit of their passing round with the apron. The feathers are to be contained between the apron and the case, and are agitated and carried round by the points; there being provision made to supply the requisite degree of heat. The claim is to "the revolving belt, with pins, or hands, revolving round two drums inside of a case adapted thereto, in the manner, and for the purpose, above specified."

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224. For a *Locomotive Power Machine for removing Houses, &c.;* Stephen Compton, Almira, Chemung county, New York, July 31.

This machine consists of a combination of wheels and pinions upon suitable shafts, operating upon a windlass; from this windlass a rope, or chain, is to be extended to a house, stump, or other body to be removed. The machine is mounted upon wheels, and is so constructed that "the end of the frame towards the resisting body may be brought into contact with the ground, this end being armed with iron, and so formed that it will enter, and form a bearing against the earth, with a power of resistance proportioned to that applied. The claim is to "the mounting of such a machine upon a carriage, constructed in the way described, so that it may readily be removed from place to place, and that it shall anchor itself, or take firm hold in the ground, by the action of the power applied, substantially in the manner shown."

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225. For *smelting Iron Ore by a composition of Anthracite and Clay as a fuel;* Joseph Lyon, Pottsville, Schuylkill county, Pennsylvania, July 31. (See Specification.)

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226. For a *Stove for Heating and Cooking;* Rufus S. Payne, West Springfield, Massachusetts, July 31.

This stove differs so little from several others, that it is not worth while to give the claim, which is only to certain special matters of arrangement.

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227. For *preparing Oleaginous Seeds for pressing;* James Crisswell Pittsburg, Pennsylvania, July 31. (See Specification.)

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228. For a *Stove for Heating apartments;* Philip Willcox, Springfield, Massachusetts, July 30.

The remarks made on stove No. 226, will apply to that now under consideration; the claim would not make known the peculiarities of construction upon which they are now founded.

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229. For a process for *removing Wool and Hair from Skins;* Benjamin F. Emery, Bath, Lincoln county, Maine, July 31. (See Specification.)

230. For an improvement in the construction of *Water Wheels*; Clayton Parker, and Robert W. Engle, Wayne, Warren county, Ohio, July 31.

This wheel, it is said, is to be "propelled mainly upon the undershot principle, and to revolve with its shaft vertical. "Its construction is peculiar, and would require drawings to make it known. The water is to pass down through openings near the periphery, which descend spirally, but differ in their arrangement and combination from others which have a resemblance to it. There is also a peculiarity in the mode of letting on the water, and of regulating its quantity. The claims are to "the giving to that part of the water wheel which is within the buckets, the form of a hollow drum, provided with openings, in its upper and lower heads, made in the manner, and for the purposes set forth. The raising or closing the gates of all the chutes simultaneously, substantially in the manner described. The plan of continuing one half of the buckets, down for about one half of the depth of the wheel, and the forming of an elbow in the other half of our buckets, half way down the wheel; thereby causing it to receive its main propelling power on the undershot principle, and to operate well in back water."

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231. For an improvement in the mode of constructing *Rail Road Frogs;* George S. Griggs, Roxbury, Massachusetts, July 31.

"By a railroad frog is meant the rails at places, where two rails cross each other. The frog has heretofore been cast or constructed in one entire piece, forming the two crossing rails for the distance of from two or three, to seven or eight feet." It is stated that from the exposure to severe shocks, and wear, at these crossing places, they are liable to great and frequent want of repair; and the improvement described, consists in providing plates of steel which are to be bolted on to the cast frogs, the bolts having flush heads. These plates can be removed when required, and new ones substituted. The claim is to "the frog plates above described, and applied as aforesaid, of whatever materials formed, and however attached to, and connected with, the main body of the frog rails."

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232. For an improvement in the machine for *Crimping Leather for Boots;* Moses S. Woodward, Marshalton, Chester county, Pennsylvania, July 31,

The improvement described consists, principally, in the means adopted for holding the leather in place whilst it is dried upon the former. The machine, in its general construction, is like several others used for the same purpose.

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233. For an improvement in the mode of constructing the *Wheels of Locomotive Engines for ascending Inclined Planes*; Elisha Town, Montpelier, Washington county, Vermont, July 31. (See Specification.)

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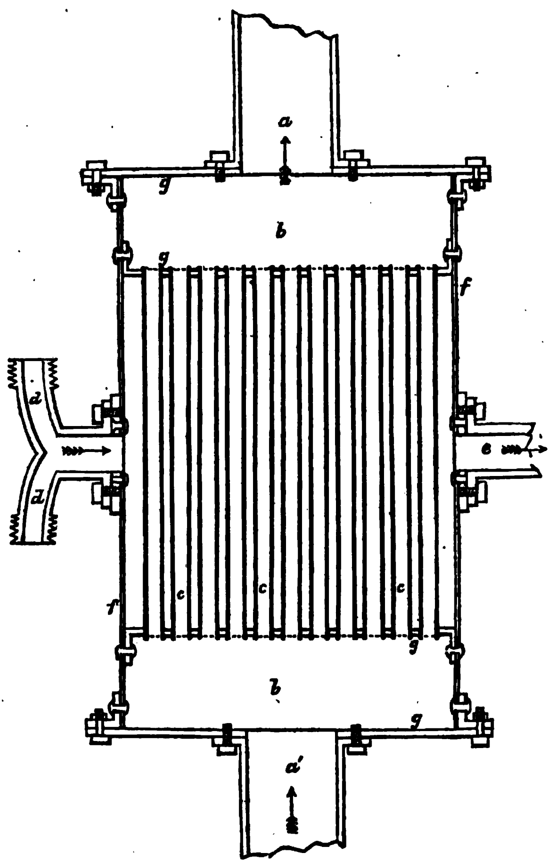
234. For a *Cooking Stove;* John Collins, Grafton, Worcester county, Massachusetts, July 31.

This stove has too much complexity in its individual arrangements to

justify the attempt to describe them verbally. The claim is to "the manner in which the heat is communicated to, and diffused through the oven of the stove or baker, in the manner described."

Specifications of American Patents.

Specification of a patent for an improvement in the mode of Heating the Water, which is forced into the boilers of Steam Engines by means of the Force Pump; granted to Ross Winans, *Civil Engineer, Baltimore, Maryland, July* 31, 1837.



To all whom it may concern, be it known that I, Ross Winans, Civil Engineer, of the city of Baltimore, in the State of Maryland, have invented an improvement in the mode of heating the water which is forced into the boilers of steam engines, by means of the force pump; and I do hereby declare that the following is a full and exact description thereof.

The apparatus which I employ is intended to expose the water to the heating influence of the waste steam from locomotive or other steam engines, as the said water is on its passage between the force pump and the boiler. This apparatus may be differently formed, but, for the purpose of illustration, I will describe it in the shape in which I have essayed it, and which I have found to answer the intention perfectly well.

I make a cylinder of metal, *f*, *f*, which may be twenty-four inches long, and fifteen inches in diameter, for an ordinary locomotive engine; this cylinder has at each end two metallic heads, *g*, *g*, which may be four inches, more or less, apart; the interior heads are perforated with numerous holes into which are inserted small tubes *c*, *c*, say of three eighths of an inch in diameter, which tubes are firmly attached, or fastened into the openings in the heads, thus establishing a number of passages through from one of the spaces *b*, *b*, between the heads at one end of the cylinder, to the space at the opposite end. The waste steam pipe, *a*, from the engine enters the head at one end of the cylinder, and a similar pipe, *a*, passes out from the opposite end; and in its passage from one to the other the steam must necessarily pass through the small tubes above named, which are contained in what may be denominated an enlargement of the waste steam pipe. In the side of the cylinder, I make two perforations, *d*, *d*, *e*, opposite to each other, into which openings the supply pipe, between the pump and the boiler is firmly inserted, thereby causing the cold water, as it passes from one segment of this supply pipe to the other, to become heated by its contact with the tubes through which the waste steam passes. The upper part of the supply pipe, between the system of heating tubes and the boiler, is furnished with a puppet, or other, valve, opening towards the boiler.

Although I have described the steam as passing through the system of small tubes, and the water as surrounding them, it will be manifest, to any one having the slightest acquaintance with the subject, that this order may be reversed, and the same effect upon the water be still produced; and also that, instead of the tubes, a system of partitions, to be alternately occupied by steam and by water, will be substantially the same with the arrangement before described.

In those locomotives, or other engines, in which the waste steam is employed to drive a blowing apparatus, as is the case with those used on the Baltimore and Ohio rail-road, and some others, the waste steam is allowed to perform this office before it reaches the heating apparatus; the means of doing which will not require any description, as it will be perfectly manifest to every competent engineer.

What I claim as my invention, and wish to secure by Letters Patent, is the heating of the water in its passage from the supply pump to the boiler, by means of an apparatus substantially the same with that herein described.

ROSS WINANS.

Specification of a patent for a new mode of Smelting Iron Ores by a mixture of anthracite and clay as a fuel; granted to JOSEPH LYON, *Pottsville, Pennsylvania, July* 31, 1837.

To all whom it may concern, be it known, that I, Joseph Lyon, of Potts-

ville, in the county of Schuylkill, and State of Pennsylvania, Collier, have invented, or discovered, an improved mode of smelting iron ores by the employment of a mixture, or composition, of anthracite and clay, as a fuel, which I call "*Clay-Coals,*" and that the following is a full and exact description of the same.

My improvement consists in reducing anthracite to a coarse powder, or screening, and mixing, or mingling, it, either by hand or machinery, with such portions of clay and water as may be requisite to bring the mass, or aggregate, to a consistence that may be readily made into balls, or be taken up by hand, or machinery, in portions of any shape, or size; when these *clay-coals* are dried, they can be used as fuel in the manner that coke, or charcoal, is commonly used in the reduction of iron ores. I intend to mingle portions of the limestone, or other fluxes, in the composition of the mixture, and also some of the finer portions of the ore, when either, or both, of these additions may be considered useful.

I do not claim the discovery, or invention, of combustible balls composed of coal and clay, for these have long been known and used for divers purposes; but what I do claim as my invention, or discovery, and desire to secure by Letters Patent, is the preparation of anthracite, or the composition of *clay-coals* as herein set forth, to be used as a substitute for coke, charcoal, or other fuel, in its application to the purposes of smelting iron ores.

JOSEPH LYON.

Specification of a patent for a new method of Heating Flax-seed, and other oleaginous seeds preparatory to expressing the oil; granted to JAMES CRISWELL, *Pittsburgh, Pennsylvania, July* 31, 1837.

To all whom it may concern; be it known, that I, James Criswell, of the City of Pittsburgh, and State of Pennsylvania, have invented a new and improved method of heating flax-seed, or other oleaginous seeds, preparatory to expressing the oil therefrom; and I do hereby declare that the following is a full and exact description.

The nature of my invention consists in conveying steam, by means of a tube, into a steam chest, flat on the top, with a rim round it; within which rim the seed is placed in such a manner as to expose it to the heat from the steam within the chest; the chest may be of any given size, dimensions, or construction, to suit the convenience of the manufacturer.

What I claim, therefore, as new, is the application of steam to the heating of flax-seed, or other oleaginous seeds, preparatory to the expressing the oil therefrom, by means of any apparatus so constructed as to expose the seed to the heating influence of the steam, no claim being made by me to the apparatus used.

JAMES CRISWELL.

Specification of a patent for a method of Softening Hides and Skins, and of removing wool, hair, and bristles from them; granted to BENJAMIN F. EMERY, *Bath, Lincoln county, Maine, July* 31*st*, 1837.

To all whom it may concern, be it known, that I, Benjamin F. Emery, of Bath, in the county of Lincoln, and State of Maine, have invented, or discovered, a new and useful improvement in the method of softening hides and

skins, and of removing wool, hair, or bristles, from them. This improvement is effected by the application of steam of the proper temperature to the hides and skins, instead of water, acids, or other materials.

For the purpose of softening dried sheep skins, for pulling the wool and tanning the skins, a room should be provided large enough to contain, suspended, as hereafter described, as many skins as it may be required to operate upon at one time, and made as nearly air-tight as it can be without much expense, say by tight boarding and shingling; with several small windows, or openings, with shutters, to admit or exclude the air, as occasion may require. I employ racks, consisting of rails, or strips of boards, or planks placed about three feet apart, and having tenter hooks inserted about four, or five inches from each other, precisely as they are now commonly used for drying sheep skins after they are tanned. As many of these may be put up in the steam room as will consist with the objects of not having the skins touch each other, and of permitting passages through them, to hang up, and take down, the skins. The steam may be generated in any kind of boiler, and conveyed by pipes from the boiler into the steam room; it is most advantageously discharged only a few inches from the floor, in the centre of the room. For a room about 12 by 15 feet square, and 9 feet high, a common potash boiler, having the steam secured, and forced into the room by a tin or copper pipe, of about two inches diameter would be sufficient, although an iron boiler resembling those used for steam engines is more convenient. Two windows of about two feet square, placed opposite each other would well answer for such a room: with the temperature of blood heat, the skins in such a room would be sufficiently steamed in about three hours, unless they were much harder than usual. It is easy to ascertain, however, by going into the room, when the wool is loose, and the skins are sufficiently pliable, taking care to lose no more steam, by keeping the door open, than is necessary. The process may be somewhat expedited by raising the temperature a little higher, although I should not advise raising it above 150 degrees of Fahr. for fear of injuring the skins. The softening will be expedited by wetting the skins or hides, before hanging them up.

Hides of neat cattle, and other large animals, may be softened for tanning in the same way; the rails and tenter-hooks being larger and farther apart, in proportion to the size of the skins, or hides. The time required for softening, will also be longer in proportion to the thickness and hardness of the skins, or hides. In all cases, the skins and hides should be affixed to the tenter hooks by the shanks, so as to keep them moderately stretched.

Slaughtered hogs, instead of being scalded in the usual way, for the purpose of scraping off the bristles, may, also, be more conveniently scalded by steam, in a similar way, where the business of dressing them is carried on to a large extent. The hogs may be hung up by the gambrils, only far enough apart to permit the butcher, or dresser, to work between them. Hot steam should then be rapidly thrown into the scalding room; until it rises to the temperature of about 175, or 180 degrees, and if very rapidly done, to the boiling point (although this is rather dangerous,) when the room should be immediately ventilated sufficiently to admit of the operation of dressing. In order to keep the labourers employed, there may be two steam rooms, so that they may operate in one room while the preparation of the hogs, and the scalding, is going on in the other.

What I claim as my invention, and desire to secure by Letters Patent, is the application of steam, instead of water, or other substances, to hides

and skins, for the purpose of softening such as are dried, and of removing the wool and hair from them, and to slaughtered hogs, for the purpose of removing the bristles.

BENJAMIN F. EMERY.

Specification of a patent for an improvement in the mode of constructing the Wheels of Locomotive Engines, for ascending Inclined Planes on Railroads; granted to ELISHA TOWN, *Montpelier, Washington county, Vermont, July* 31, 1837.

Be it known, that I, Elisha Town, of Montpelier, in the county of Washington, and state of Vermont, have invented a new and improved mode of constructing the wheels of locomotive engines used on Railroads, so as to ascend and descend inclined planes without the aid of any other power than that of the engine belonging thereto, to propel the same; called "Elisha Town's Improved Engine Wheel for inclined planes," and I do hereby declare that the following is a full and exact description.

The nature of my invention consists in attaching a wheel of proper dimensions, with a groove in its rim, similar to the wheels used to propel machinery by round bands, to the inside of such of the wheels of the *locomotive* that run on the rails on the level road, as the power of the engine is applied to, in propelling the engine car. At the commencement of the inclined plane, the ordinary rail stops, and another of the same shape, starts, but laid within the other, to correspond to the grooved wheels, and as the grooved wheels come on to this, it raises the other wheels from the ordinary rail, and the groove, by embracing both sides of the rail, produces sufficient friction to enable the locomotive to propel itself, and a train of cars, up the inclined plane.

The grooved wheel should be proportioned in size, and the bevil of the groove should vary in its inclination, to the steepness of the ascent to be overcome, and should be used only on the inclined plane.

It is proposed to use the ordinary kind of rolled iron rail, hardened, to run the grooved wheels on; but cast iron, or steel, of a similar shape, may be used.

For the cars, there should be a set of wheels with two bearings to each, with a flanch in the centre, between the bearings; one bearing for the bevil rail, and the other for the inclined plane.

The rails to the inclined plane must run past the ends of the horizontal rails, sufficiently far to have the wheels pass properly from one set of rails to the other.

What I claim as my invention, or improvement, and desire to secure by letters patent, is the application of grooved wheels to locomotives to enable them to propel themselves and a train of cars up an inclined plane.

ELISHA TOWN.

Specification of a patent for manufacturing White Lead, and other salts of lead; granted to HOMER HOLLAND, *Westfield, Hampden county, Massachusetts, March* 13*th*, 1836.

To all to whom these presents shall come, be it known, that I, Homer Hol-

land, of the town of Westfield, county of Hampden, and State of Massachusetts, have invented a new and useful improvement in the process for oxidizing metallic lead; and for making and producing carbonate of lead, or the pigment commonly known by the name of white lead, which improvement has not heretofore been known or used, and that the following is a full and exact description of said improvement, sufficient to distinguish the same from all things before known, and to enable any person skilled in the art or science of making and producing the salts, acetate and nitrate of lead, from any oxide, or the carbonate of lead, to apply and use said improvement in the making and compounding of the same.

The invention consists:

1st. In an improvement in the method of applying the conjoint action of friction, air, and water, to metallic lead, by placing fragments of this metal in revolving lead cylinders, or chambers, so as to produce a fine powder or pulpy suboxide of lead, for making or producing the commercial salts, nitrate and acetate of lead.

2nd. In combining carbonic acid, from the atmosphere, directly with this suboxide, as it is formed in the cylinder by the addition of carbonate of soda, or other alkaline carbonate, so as to produce, or make, the carbonate of lead, or the pigment known as white lead. To effect the oxidation of the lead, I put coarse shot, or other fragments of unalloyed lead, into a leaden cylinder, or chamber, about four feet in length, and three in diameter, made to revolve, horizontally, upon an axis of flanches. The leaden cylinder, or chamber, is enclosed in a strong and tight wooden case; air is admitted by perforations of the cylinder, at the ends, near the axis; soft water is put in the chamber, sufficient to cover the charge of shot or fragments. The cylinder is made to revolve eighteen or twenty times in a minute, by the application of any force, and the electro-chemical action of the friction, air and water, produces a fine, pulpy suboxide of lead which is strained out by removing a bung from the side of the cylinder, and placing therein a hollow tube, leading to a sieve, or strainer, resting in a canal, or trough, which conducts to a reservoir.

This pulpy suboxide sufficiently freed from water, is readily combined with acetic acid, this giving "sugar of lead," and, with nitric acid, producing nitrate of lead. To make carbonate of lead, the process is identical with the above-described for the suboxide, with the addition of about six or eight ounces of the carbonate of soda to each gallon of water used in the cylinder. The cylinder is revolved several hours in producing the suboxide for the salts of lead, and from twelve to sixteen previous to straining out the carbonate, or white lead, which is conducted, as above described, to a vessel armed with an agitator and washed by decantation with pure water, once or twice, to free it from alkali, when it is to be dried by any convenient means, becoming the pure carbonate, "or cream," white lead of commerce. In this process, for white lead, the use of vinegar and of acetic, or acetous acid in any shape, is avoided, and the health of manufacturers is preserved from the fumes of the volatile peracetate of lead so deadly in the ordinary process. The foregoing process I prefer; but the revolving chambers may be cylindrical, square, or polygonal, of any size and length. The lead lining of a wooden cylinder may be of sheet lead, or cast in cylinders to fit the wooden case, or carcass, and the cylinders are to be renewed from time to time, as they frit away. The number of cylinders, their weight, and the charge, will depend on the force employed, and the extent of the manufacture. Each cylinder (principally the lead chambers) may

weigh six hundred pounds. The charge added, from one hundred to one hundred and fifty pounds of fragments, and the necessary water and carbonate of soda. The lead fragments may be shreds of sheet lead, shot, or fragments produced by pouring melted lead through a colander into water. Antimony and other alloys of metals are often mingled with lead in the shot of commerce, and unfit them for this process. The alkali preferred is soda, as this has the strongest affinity, or attraction, for oxygen and carbonic acid, and is less liable to form an hydrate. The pulpy suboxide may also be conveniently carbonated in the vessel employed for decantation, as it is armed with agitators, by passing into the pulpy suboxide, as it is withdrawn from the cylinders, carbonic acid produced by the combustion of charcoal, from fermentation, or from the decomposition of carbonate of lime, or chalk, by sulphuric, or hydrochloric acid. The decanting vessel, again, may be used conveniently in removing a disagreeable yellowness from pure carbonated lead by minutely mingling a trifle of indigo, or blue smalts, with the carbonate of lead. I claim as my invention and improvement,

1st. The application of the revolving cylinders, or chambers, as above described, to the fritting, comminution, amalgamation, or converting of metallic lead into the fine, pulpy suboxide of lead, for the salts, acetate and nitrate of lead, or carbonate of lead.

2nd. The carbonating of the above described suboxide, as it is formed in the cylinder, by the addition of an alkaline carbonate, or by passing into this pulp directly, carbonic acid, giving immediately white lead.

HOMER HOLLAND.

Progress of Practical and Theoretical Mechanics and Chemistry.

NOTICES FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

New observations on Magnesian Hydraulic Lime. By M. VICAT. (Academy of Sciences, Jan. 16, 1837.)

M. Berthier has excited some doubts with respect to the chemical fact, which I recently communicated to the Academy,—namely, whether magnesia, when it occurs in the proportions of thirty or forty parts, can render hydraulic, forty parts of very pure lime.

Through deference to the opinion of this learned chemist, I have verified afresh the synthesis which served as the basis of my conclusion; and, in order to remove the possible causes of error, I desired the chief Engineer of mines, Gueymard, (in whose laboratory I was operating) to select and verify himself the carbonates of lime and magnesia, destined for the experiment.

He consequently placed at my disposal—1st. white marble from Val-Senestre, (Isère) which, in 100 parts contained;

Silica,	0.068	100
Carbonate of Magnesia,	0.020	
Carbonate of lime,	99.912	

2nd. Some Carbonate of magnesia of the shops which contained;

Magnesia,	46.00	100
Carbonic acid,	51.60	
Water,	2.40	

The silica in the lime stone from Val-Senestre, does not amount, as we perceive to $\frac{1}{1000}$, and is therefore an insignificant ingredient.

Having calcined several fragments of the limestone, until the carbonic

acid was almost completely expelled, I obtained lime, pure, within a thousandth at least, and I weighed 44 parts of it. I weighed also 80 parts of carbonate of magnesia, representing 36.80 of anhydrous magnesia. The lime was slaked into a cream, and mixed with the magnesia previously pulverized and passed through a silk sieve. After long trituration, the mixture, still too liquid to be managed, was partially dried, then divided into small balls, and placed in the muffle of a cupelling furnace, where it was exposed during four hours to a red heat.

The factitious lime thus obtained promptly dissolved with active effervescence in water. Reduced to a paste of good consistence, and placed in the bottom of a vessel and covered with water, it set in the course of a week, and on the 9th day the wet surface bore, without depression, a common knitting needle loaded with 300 grammes, (=10 oz.)

This second experiment therefore fully confirms the previous results, and solves the doubts of the honorable Academician alluded to. It explains satisfactorily the hydraulic character of the natural limestones of Sardin, (Dordogne) whose composition, taking the mean, is

Silica,	5.00
Alumine,	2.00
Oxide of iron,	0.40
Carbonate of Magnesia,	42.00
Carbonate of lime,	50.60
	100.00

In fact, if magnesia served merely as an inert material, like fine sand, for example, the lime of Sardin, containing pure lime and silica in the proportion of 100: 10 would be only half hydraulic,—whereas its well established qualities place it in the rank of good common hydraulic lime. The large quantity of magnesia which it contains, thus evidently supplies what it was wanting in silex.

In granting the accuracy of our results, M. Berthier, however, pretends that the principle is of no consequence in practice;—but there is perhaps a little too much haste in the desire to set bounds to the useful application of this or that principle; for, if I am correctly informed, the publication of my first note would have had some effect in recalling the attention of builders to the dolomites which have been rejected in various places, because, giving up to the acids only five or six hundredths of the argillaceous residue they despaired of obtaining from them a lime sufficiently hydraulic.

Mr. Dumas recollected:—that Mr. Fuchs had published a few years ago, in Bavaria some observations tending to prove that magnesia had a useful action in hydraulic mortars. He endeavoured especially to point out the great advantage that might be obtained by using dolomite, and he proved that with a puzzolana which produced only a very moderate effect when used with fat lime, mortar of an excellent quality was obtained in combination with magnesian lime.

Jour. des Mines, 3liv. de 1837.

Fossil Bones.

Among the fossil bones discovered on the borders of the Jamma, in India, some are of a blackish brown, shining, brittle, and having a conchoidal fracture. Spec. grav. 415, and their composition proves to be,

Phosphate, and carbonate of lime,	.175
Red oxide of iron	.765
Water,	.060
	1.000

The bones found on the Jamma, belong to elephants, hippopotami, Deer, Antelopes, Cattle, Horses, Hogs, Water Rats, Saurians, and others much resembling Camelopards. Idem.

On the Carbonate of Magnesia of Southern India. By M. Prinsep, (Asiat. Jour.)

This mineral which is found at Salem, is met with in veins of limited extent, from one inch to a foot in thickness, and sometimes also in beds. It snaps when applied to the tongue. Sp. gr. from 2.87 to 2.887. It is a pure neutral, anhydrous carbonate. When calcined, and water is poured on the magnesia, the latter absorbs about $\frac{1}{10}$ of its weight of the liquid with a disengagement of heat, and the water does not escape by the action of sulphuric acid in a vacuum. Idem.

Analyses of two Vegetable Soils in the vicinity of Puiseaux, department of Loiret. By M. P. Berthier.

1st. *Soil eminently adapted to the cultivation of Saffron.*—Large quantities of this plant have been grown around the town of Puiseaux, from time immemorial. It is not, however, every part of the country, that is fit for its culture;—only land of the best quality is devoted to it. The specimen subjected to analysis was taken from a field reputed to be excellent.

The soil is of a blond, verging upon a brown colour. By sifting and levigation only 15 per cent. of stony matters, in general very small, were separated, rarely of the size of a pea. These grains are fragments of freshwater limestone mingled with quartz. I found in the native soil:

Carbonate of lime,	.370
Silex and quartzose sand,	.454
Alumine,	.093
Oxide of iron,	.020
Water and organic matter,	.063
	1.000

Agreeably to the ordinary composition of clay, there is reason to believe that it amounts in this soil to 30 per cent. including .247 of quartzose sand; but this sand is so fine, it is absolutely impossible to separate it by levigation.

When the soil of Puiseaux is moistened, it absorbs much water, and becomes a viscid paste, which loses its consistency by drying. It is very permeable to roots, on account of the great proportion of sand and grains of calcareous matters which it contains.

2nd. The second soil was taken from the park Gauthier, which has hitherto been kept in wood. It is of a blond colour. It forms a pasty mass with water, which when dry contracts and splits, and the pieces assume the

consistency of crude pottery: yet, by calcination, it acquires very little solidity. The analysis of this soil gave.—

Carbonate of lime,	.010
Silex of quartzose sand,	.785
Alumine,	.110
Oxide of iron,	.030
Water and organic matter,	.065
	1.000

This soil must contain about 33 per cent. of clay and consequently .565 of quartzose sand.

The analysis shows that the soil of park Gauthier, has very nearly the same composition as the non-calcareous portion of the Saffron soil, and that it might be improved by adding half its weight of limestone earth in powder. Idem.

Analysis of a vegetable soil from Cuba. By M. P. Berthier.

This soil was sent to the laboratory by M. Mollien, consul general of France, at Havanna. It is that in which sugar, coffee and tobacco are raised with so much success. It is red, resembling an earthy ferruginous mineral. It is in small agglomerated masses, but is very easily crushed. No stony matters are discoverable, but vegetable remains are conspicuous, apparently proceeding from sugar cane. It exhales a disagreeable odour, analogous to sheep dung. It forms a paste with water, which contracts on drying, without splitting, and acquires much tenacity. It would form an excellent material for red antique pottery.

By levigating and sifting, only two per cent. are separated of white calcareous fragments, and vegetable fibres. Dried at the boiling heat it loses .99 of hygroscopic water. It contains:

Carbonate of lime,	.080	
Peroxide of iron,	.140	
Oxide of manganese	.010	
Silica	.336	clay .506
Alumine	.170	
Water and organic matter	.250	
	9.86	

The organic matters are equivalent to .04 of carbon.

This soil must retain water very firmly, and also acquire great stiffness, or hardness, in drying by the sun, and it is difficult to conceive how the roots of plants can get through it. Idem.

Analysis of the Sulphate of Iron of Nordhausen. By M. P. Berthier.

This salt is that from which the smoking sulphuric acid of Nordhausen is made. It is in amorphous pieces, has a granular fracture, white inside, and of a sulphur yellow on the outside. It dissolves wholly in water, and forms a colourless solution. Heated to dull redness in a platina crucible it undergoes semi-fusion, and loses at least .35 of water without disengaging any sulphurous, or sulphuric, acid. It is composed of

Peroxide of iron	.165
Protoxide of iron	.085
Sulphuric acid	.344
Water	.406
	1.000

It is a mixture of the sulphate of the protoxide and the sulphate of the peroxide of iron, both neutral. It results probably from the evaporation of the solution of sulphate of iron which has remained a long time exposed to the air.

This salt was sent as having been calcined in a reverberatory furnace; but the great quantity of water it contained, gives reason to believe it was only dried in pans. Ibid.

Analysis of a substance employed in colouring Porcelain purple. By M. Malagutti.

The English potters ornament their beautiful ware with designs printed in a very agreeable purple red, which they call pink colour. I found this material composed of

Stannic acid	.780
Lime	.150
Silica	.030 to .040
Alumine	.020
Oxide of chrome	.005
Chromate of lime, or potash	.003
	.988

In combining, by strong calcination, 100 of stannic acid, 34 of chalk, 1 to 1½ of Oxide of chrome, or 3 to 4 of crystalized chromate of potash, we obtain a colour very similar. We may add, if we wish, 5 of silica and 1 of alumine. The mass is of a dirty red; but it becomes a beautiful rose after it has been washed with water weakly acidulated by muriatic acid.

The experiments that I have made have proved, 1st, that stannic acid is coloured by chromate of potash or by the oxide of chrome at a red heat only when lime is added; 2d, that silex and alumine, without being indispensable, enhance the colour and turn it to a violet; 3d, and that the more cime and chromate of potash or oxide of chrome we add, the deeper the eolour becomes, and that it may gradually attain to a chesnut brown.

If we heat to 150° C. (= 300° F.) a mixture of 100 parts of stannic acid and 2 of oxide of chrome, we have a compound consisting of small vitreous grains of a superb lilac colour. This compound which I call *mineral lac*, resists every decomposing agent, and may be applied, not only to the colouring of paper hangings, and to pottery, but also to oil painting as a subititute for the vegetable lac which painters are obliged to use to obtain a similar colour.

The question of determining the precise condition of the chrome in the pink colour, and in the mineral lac, is a difficult one to solve. Nevertheless every thing induces me to believe it to be in the state of an oxide, and not in that of acid, in the preparation of pink colour.

The presence of lime makes up for the temperature to which we have recourse in the fabrication of mineral lac, to determine the combination of the oxide of chrome with stannic acid.

The principal considerations on which I found my opinion are the following; 1st, many of the salts of chrome are violet; chrome alum, melted in its water of crystalization, is green, but it becomes lilac if we heat it slightly red; 2d, the oxide of chrome, heated in vacuo with stannic acid and lime, gives a pink colour; 3d, stannic acid, which can be feebly coloured by the oxide of chrome at a clear red heat, is inattackable by muriatic acid, whilst pink colour, after it has been washed with acidulated water, is attacked by that acid, so that it dissolves the whole of the lime, almost the whole of the oxide of chrome, and such a proportion of the stannic acid, that it contains a neutral stannate of lime; 4th, when we calcine lime with the oxide of chrome in contact with air, chromate of lime is formed, and a combination of that earth and of the oxide of chrome, soluble in weak acids, from which it is precipitated by alkalies in the cold. Idem.

Analysis of a double Phosphate of Lead and Lime. By M. BARUEL.

This mineral was discovered in the mine of Nussiere, near Beaujeu, by M. Danhauser. It is sometimes in crystals, which are very obtuse rhombohedrons, almost lenticular, sometimes mamellated. Its fracture is somewhat splintery; its lustre is greasy and faint; its colour yellow, greenish, or grayish; its powder of a yellowish white. Its density is 5.0415. It rests on hyaline quartz. I have found the mamelonaceous variety to be composed of

Quartz	.0720	
Chloride of lead	.0765	Oxygen.
Oxide of lead	.4650	.0330
Lime	.1230	.0345
Protoxide of iron	.0244	.0055
Phosphoric acid	.1980	.1110
Arsenic acid	.0406	.0141
	.9995	

From these data it must be considered as formed of

Mixed quartz		.0720	
Chloride of lead	(Cl. Pb)	.0765	1 atom.
Phosphate of lead	$(\overset{\cdot\cdot\cdot\cdot\cdot}{P}\ \dot{Pb}^3)$	.5640	7
Phosphate of lime	$(\overset{\cdot\cdot\cdot\cdot\cdot}{P}\ \dot{Ca}^3)$	.2220	7
Arseniate of iron	$(\overset{\cdot\cdot\cdot\cdot\cdot}{As}\ \dot{Fe}^2)$	.0650	2

Idem.

On a large and very sensible Thermoscope Galvanometer. By JOHN LOCKE, M. D. *Professor of Chemistry in the Medical College of Ohio.*

The chief novelty of the instrument which I am about to describe, consists in its proportions and the resultant effects. The object which I proposed in its invention was to construct a thermoscope so large that its indications might be conspicuously seen, on the lecture table, by a numerous assembly, and at the same time so delicate as to show extremely small changes of temperature. How far I have succeeded will in some measure appear by a very popular, though not the most interesting experiment which may be performed with it. By means of the warmth of the finger

applied to a single pair of bismuth and copper disks, there is transmitted a sufficient quantity of electricity to keep an eleven-inch needle, weighing an ounce and a half, in a continued revolution, the connexions and reversals being properly made at every half turn.

The greater part of this effect is due to the *massiveness* of the coil, which is made of a copper fillet about fifty feet long, one-fourth of an inch wide, and one-eighth of an inch thick, weighing between four and five pounds. This coil is not made in a pile at the diameter of the circle in which the needle is to revolve, but is spread out, the several turns lying side by side, and covering almost the whole of that circle above and below. The best idea may be formed of the coil by the manner in which it is actually modeled by the workman. It is wound closely and in parallel turns on a circular piece of board eleven and a half inches in diameter and half an inch in thickness, covering the whole of it except two small opposite segments, of about 90 degrees each. The board being extracted leaves a cavity of its own shape to be occupied by the needle.

The copper fillet is not covered by silk, or otherwise coated for insulation, but the several turns of it are separated at their ends, by veneers of wood, just so far as to prevent contact throughout. In the spreading out and compression of the coil it is similar to Melloni's elegant apparatus, though in my isolated situation in the interior of America, I was not acquainted with the structure adopted in his prior invention. In the *massiveness* of the coil my instrument is perhaps peculiar, and by this means it affords a free passage to currents of the most feeble intensity, enabling them to deflect a very heavy needle. The coil is supported on a wooden ring furnished with brass feet and leveling screws, and surrounded by a brass hoop with a flat glass top or cover, in the centre of which is inserted a brass tube for the suspension of the needle by a cocoon filament. The needle is the double astatic one of Nobili, each part being about eleven inches long, one-fourth wide, and one-fortieth in thickness. The lower part plays within the coil and the upper one above it, and the thin white dial placed upon it, thus performing the office of a conspicuous index underneath the glass.

I have not yet made any very extensive experiments with this instrument, being only just now prepared to do so. It is very sensible to a *single* pair of thermo-electric metals, to the action of which it seems peculiarly adapted; but the efficiency of such metals is increased by a repetition of the pairs, as in the thermo-pile of M. Melloni, especially if they be massive in proportion to the coil itself. With a battery of five pairs of bismuth and antimony, the needle was sensibly moved by the radiation from a person at the distance of twelve feet, without a reflector, the air being at the temperature of 72°.

In a recent interview with M. Melloni, to whose politeness I am much indebted, he expressed his opinion that with a thermo-pile massive in proportion to the coil, my galvanometer might be made to exhibit his thermo-experiments advantageously to a large class. Some idea may be formed of its fitness for this purpose from the result of a single trial on transmission. The heat from a small lamp with a reflector, at the distance of five feet, passed through a plate of alum, and falling on a battery or pile of five pairs of bismuth and antimony, deflected the needle only a fraction of one degree, but on substituting a similar plate

of common salt, the same heat produced, by impulse, an immediate deflection of 33 degrees.

Although the instrument is finely adapted by its size for the purpose for which it was intended, class illustration, yet from the weight of the needle and the difficulty of bringing it to rest after it once acquires motion, it is not so suitable for experiments of research as the Mellonian galvanometer. When a massive thermo-pile, such as has lately been made by Messrs. Watkins and Hill of Charing-cross, is connected with the coil and excited by a heat of about 200°, the needle being withdrawn a distinct spark is obtained on interrupting the circuit; in producing this effect it is less efficient however than the ribbon coil of Prof. Henry. The tube for suspension, placed over the centre of the instrument, is so constructed as to admit of being turned round by means of an index, which extends from it horizontally over the glass cover, and thus any degree of torsion may be given to the suspending filament or wire. A wire of any desired thickness may be easily substituted for the cocoon filament, when the instrument becomes adapted to measuring the deflecting forces of the galvanic battery. By using a thick wire it was ascertained that the calorimotor of Professor Hare, having forty plates, each eighteen inches square, acted on the needle with a force equal to ninety-two grains, applied at the distance of six inches from the centre. In attempting to force the needle by torsion into a line parallel to the coil, where the deflecting current acts with the greatest strength, I accidentally carried it too far and reversed its *position*, when instantly it became reversed in *polarity*, that which had been the north pole becoming south. This showed how unfit is the magnetic needle to measure such a quantity of electricity as was then flowing through the massive conductor. The instrument is well adapted to show to a class the experiments upon radiant heat with Pictet's conjugate reflectors, in which the differential, or air, thermometer affords, to spectators at a distance, but an unsatisfactory indication. For this purpose, the electrical element necessary is merely a disk of bismuth as large as a shilling, soldered to a corresponding one of copper, blackened, and erected in the focus of the reflector, while conductors pass from each disk to the poles of the galvanometer. With this arrangement the heat of a non-luminous ball at the distance of twelve feet will impel the needle nearly 180°, and if the connexions and reversals are properly made will keep it in a continued revolution.

I have thus given you a brief sketch of an instrument which seems to supply a desideratum on the lecture-table, when the common thermometer is too small to afford to a class that direct and full satisfaction which, in a subject so important as that of heat, is very desirable to every professor. I have not, so far, attempted to use it extensively as an instrument of research, yet it shows evidently the importance of massiveness in conductors for feeble currents, such as those produced by thermo-combinations; nor am I certain that I have arrived at a maximum in this particular, for so far as I have proceeded in using thicker conductors for the coil, the deflecting effects have been increased.

I am, &c.

JOHN LOCKE.

London, Aug. 30, 1837. Lond. & Edin. Philos. Mag.

Description of the Borax Lagoons of Tuscany.

The borax lagoons of Tuscany are entitled to a detailed description. They are unique in Europe, if not in the world; and their produce has become an article of equal importance to Great Britain, as an import, and to Tuscany, as an export. They are spread over a surface of about thirty miles, and exhibit, from the distance, columns of vapour, more or less according to the season of the year and state of the weather, which rise in large volumes amongst the recesses of the mountains. As you approach the lagoons, the earth appears to pour out boiling water as from volcanoes of various sizes, in a variety of soil, but principally of chalk and sand. The heat in the immediate adjacency is intolerable, and you are drenched by the vapour which impregnates the atmosphere with a strong and somewhat sulphurous smell. The whole scene is one of terrible violence and confusion—the noisy outbreak of the boiling element—the rugged and agitated surface—the volumes of vapour—the impregnated atmosphere—the rush of waters among bleak and solitary mountains. The ground, which burns and shakes beneath your feet, is covered with beautiful crystalizations of sulphur and other minerals. The character beneath the surface at Mount Cerbole is that of a black marl streaked with chalk, giving it at a short distance the appearance of variegated marble. Formerly the place was regarded by the peasants as the entrance to hell, a superstition derived, no doubt, from very ancient times; for the principal lagoons and the neighboring volcano still bear the name of Monte Cerbole. (*Mons Cerberi.*) The peasantry never passed by the spot without turning their heads and praying for the protection of the virgin. The borax lagoons have been brought into their present profitable action within a very few years; scattered over an immense district, they have become the property of an active individual, M. Larderel, to whom they are a source of wealth, more valuable, perhaps, and certainly less capricious than any mine of silver that Mexico or Peru possesses. The process of manufacture is simple, and is effected by those instruments which the neighbourhood itself presents. In these spots artificial lagoons are formed by the introduction of the mountain streams. The hot vapour keeps the water continually in boiling ebullition, and after it has received its impregnation during twenty-four hours at the most elevated lagoon, the contents are allowed to descend to the second lagoon, where a second impregnation takes place, and then to the third, and so forth, till it reaches the lowest receptacle, and having thus passed through from six to eight lagoons, it has reached one half per cent. of the boracic acid. It is then transferred to the reservoirs, from whence, after a few hours rest it is conveyed to the evaporating pans, where the hot vapour concentrates the strength of the acid, by passing under shallow leaden vessels, from the boiling fountains above, which it quits at a heat of eighty degrees of Réaumur, and is discharged at a heat of sixty degrees. There are from ten to twenty pans, in each of which the concentration becomes greater at every descent, till it passes to the crystallizing vessels, from whence it is carried to the drying-rooms, when, after two or three hours, it becomes ready to pack for exportation. The number of establishments is nine. The whole amount produced varies from 7000lbs. to 8000lbs. (of twelve oz.) per day. The produce does not appear susceptible of

much extension, as the whole of the water is turned to account. The atmosphere has, however, some influence on the result. In bright and clear weather, whether in winter or summer, the vapours are less dense but the depositions of boracic acid in the lagoons are greater. Increased vapours indicate unfavourable change of weather, and the lagoons are infallible barometers to the neighbourhood, even at a great distance, serving to regulate the proceedings of the peasantry in their agricultural pursuits. It had been long supposed that the boracic acid was not to be found in the vapours of the lagoon; and when it is seen how small the proportion of acid must originally be, it will not be wondered at that its existence should have escaped attention. In the lowest of the lagoons, after five, six, and in some cases a greater number of impregnations, the quantity of boracic acid given out does not exceed one half per cent.; thus, if the produce be estimated at 7500lbs. per day, the quantity of saturated water daily discharged is 1,500,000lbs. Tuscan or 500 tons of English.

The lagoons are ordinarily excavated by the mountaineers of Lombardy, who emigrate into Tuscany during the winter season, when their native Appenines are covered with snow. They gain about one Tuscan lira per day. But the works are conducted, when in operation, by natives, all married, and who occupy houses attached to the evaporating pans. They wear a common uniform, and their health is generally good. A great improvement in the cultivation, and a great increase in the value of the neighboring soil, has naturally followed the introduction of the manufacture of the boracic acid. A rise of wages has accompanied the new demand for labour; much land has been brought into cultivation by new directions given to the streams of smaller rivers. Before the boracic lakes were turned to profitable account, their fetid smell, their frightful appearance, agitating the earth around them by ceaseless explosions of boiling water, and not less the terrors with which superstition invested them, made the lagoons themselves to be regarded as public nuisances, and gave to the surrounding country a character which alienated all attempts at improvement. Nor were the lagoons without real and positive dangers, for the loss of life was certain where man or beast had the misfortune to fall into any of those boiling baths. Cases frequently occurred in which cattle perished; and one chemist, of considerable eminence, met with a horrible death by being precipitated into one of the lagoons. Legs were not unfrequently lost by a false step into the smaller pit *(palizze)* where before the foot could be withdrawn, the flesh would be separated from the bone.

Min. Jour.

Description of Mr. Henry Guy's method of giving a true spherical figure to balls of metal, glass, agate, or other hard substance. Communicated by Bryan Donkin, Esq., V. P. Inst. C. E.

The method adopted by Mr. Guy, consists simply in applying to practice the principle, that if a ball can be made to revolve rapidly in every possible direction, or in other words, if during such revolution its axis of rotation be constantly changing its angular position within the ball itself, whilst a grinding tool is applied to the surface of the ball, the most prominent parts of that surface will be first acted on by the grinder, and by continuing the operation the whole of the high

er parts of the surface will be progressively ground off, and the ball will ultimately be left of a perfect spherical shape. Mr. Guy effects this by placing the ball betwixt the faces of two wooden chucks fixed to two lathe mandrels, such as are used in common turning lathes with their axes exactly in a line with each other. A quick motion is given to the mandrels in the usual way by two bands, so applied that the mandrels are placed in opposite directions; the ball, being compressed betwixt the chucks; turns, notwithstanding the friction of the tool. The tool is a bar of brass or iron, with a conical hole near one end, the larger diameter of which is made a little larger than the diameter of the ball.

Jour. of Arts and Sciences.

Whishaw's Hydraulic Telegraph.

We have long ago heard it suggested, and we think by Mr. Vallance, that a column of water could be conveniently employed to transmit information. Mr. Francis Whishaw has conveyed a column of water through sixty yards of pipe in the most convoluted form, and the two ends of the column being on a level, motion is no sooner given to one end than it is communicated through the whole sixty yards to the other end of the column. No preceptible interval elapses between the time of impressing motion on one end of the column and of communicating it to the other. To each end of a column he attaches a float board with an index, and the depression of any given number of figures on one index, will be immediately followed by a corresponding rise of the float board and index at the other end. It is supposed that this simple longitudinal motion can be made to convey all kinds of information. It appears to us that the amount of information which can be conveyed by the motion in one direction only, of the water, or backward and forwards, must be limited. To make the mere motion backwards and forwards of a float board, indicated on a graduated index, convey a great number of words or letters, is the difficulty to be overcome. Mr. Whishaw has exerted his ingenuity in this way, with a promise of success, and by-and-bye, the hydraulic telegraph may supersede the semaphore and the galvanic telegraph.—*Courier.* Lond. Mech. Mag.

Incombustible Thatch.

This is a subject which I look upon as highly important to the "rural population" of this, and every other country, where houses, barns, and other buildings are so often covered with straw or thatch.

It is announced, that a Mr. G. B. Barentin, of Leipsic, has invented a method of rendering the thatching of buildings fire-proof. Alum, as is justly observed, will render all vegetable tissues, or fibres, incombustible; that is, its application in solution will prevent their burning in a flame. Any one may prove this with a piece of sheet or old cotton handkerchief. But then the alum being soluble, the rain will wash it out, and carry off the preserving substance, perhaps the day after its application.

A sure and cheap method of rendering straw thatch incombustible, which I have experimented upon and proved, to my entire satisfaction, is to saturate the thatch once with a solution of lime in water, or with

what is commonly used as whitewash. The addition of one pound of alum to every five gallons of whitewash, will greatly improve the composition, and it will remain in the pellicle of lime which covers every straw, so as never to be washed out by the rain. I have poured a bucket of whitewash over a heap of dry furze, then kept it in the July sun until as dry as possible, and then (let any man try it) it will not burn, even aided by ten pair of bellows.

When any building is being thatched, what more easy and cheap than to keep paying the straw with such whitewash? It will also prevent corruption, and cause the thatch to last incomparably longer than that of clean straw. Of course, the solution of lime should have the addition of a little size. The lime, size, and alum will form a crust insoluble in water, protecting each straw to which it adheres. Of course, the straw next the house must be protected as well as the exterior.

I wonder how any family can sleep quietly under a roof that may be set in a blaze by a spark from a chimney, or from a pipe, or a cigar, or a flash of lightning! We almost daily hear of people being burnt out of their cottages in Ireland, by the thatch being ignited. I hope your readers will think of this preservative, try it, and promulgate its importance. I have the honour to be, Sir, your obedient servant,

FRANCIS MACERONI.

Ibid.

Progress of Physical Science.

On the Formation of Mould, by CHARLES DARWIN, Esq., F. G. S.

The author commenced by remarking on two of the most striking characters by which the superficial layer of earth, or, as it is commonly called, vegetable mould, is distinguished. These are its nearly homogeneous nature, although overlying different kinds of subsoil, and the uniform fineness of its particles. The latter fact may be well observed in any gravelly country, where, although in a ploughed field, a large proportion of the soil consists of small stones, yet in old pasture-land not a single pebble will be found within some inches of the surface. The author's attention was called to this subject by Mr. Wedgwood, of Maer Hall, in Staffordshire, who showed him several fields, some of which, a few years before, had been covered with lime, and others with burnt marl and cinders. These substances, in every case, are now buried to the depth of some inches beneath the turf. Three fields were examined with care. The first consisted of good pasture land, which had been limed, without having been ploughed, about twelve years and a half before: the turf was about half an inch thick; and two inches and a half beneath it was a layer, or row, of small aggregated lumps of the lime forming, at an equal depth, a well-marked white line. The soil beneath this was of a gravelly nature, and differed very considerably from the mould nearer the surface. About three years since cinders were likewise spread on this field. These are now buried at the depth of one inch, forming a line of black spots parallel to, and above, the white layer of lime. Some other cinders, which had been scattered in another part of the same field, were either still lying on the surface, or entangled in the roots of the grass. The second field examined was remarkable only from the cinders being now buried in a layer, nearly an inch thick,

three inches beneath the surface. This layer was in parts so continuous, that the superficial mould was only attached to the subsoil of red clay by the longer roots of the grass.

The history of the third field is more complete. Previously to fifteen years since it was waste land; but at that time it was drained, harrowed, ploughed, and well covered with burnt marl and cinders. It has not since been disturbed, and now supports a tolerably good pasture. The section here was, turf half an inch, mould two inches and a half, a layer one and a half inch thick, composed of fragments of burnt marl (conspicuous from their bright red colour, and some of considerable size, namely, one inch, by a half broad, and a quarter thick,) of cinders, and a few quartz pebbles mingled with earth; lastly, about four inches and a half beneath the surface was the original, black, peaty soil. Thus beneath a layer (nearly four inches thick) of fine particles of earth, mixed with some vegetable matter, those substances now occurred, which, fifteen years before, had been spread on the *surface*. Mr. Darwin stated that the appearance in all cases was as if the fragments had, as the farmers believe, worked themselves down. It does not, however, appear at all possible, that either the powdered lime or the fragments of burnt marl and the pebbles could sink through compact earth to some inches beneath the surface and still remain in a continuous layer. Nor is it probable that the decay of the grass, although adding to the surface some of the constituent parts of the mould, should separate, in so short a time, the fine from the coarse earth, and accumulate the former on those objects which so lately were strewed on the surface. Mr. Darwin also remarked, that near towns, in fields which did not appear to have been ploughed, he had often been surprised by finding pieces of pottery and bones some inches below the turf. In a similar manner on the mountains of Chili he had been perplexed by noticing elevated marine shells, covered by earth, in situations where rain could not have washed it on them.

The explanation of these circumstances, which occurred to Mr. Wedgwood, although it may, at first, appear trivial, the author did not doubt is the correct one, namely, that the whole is due to the digestive process, by which the common earth-worm is supported. On carefully examining between the blades of grass in the fields above described, the author found, that there was scarcely a space of two inches square without a little heap of the cylindrical castings of worms. It is well known that worms swallow earthy matter, and that having separated the serviceable portion, they eject at the mouth of their burrows, the remainder in little intestine-shaped heaps. The worm is unable to swallow coarse particles, and as it would naturally avoid pure lime, the fine earth lying beneath either the cinders and burnt marl, or the powdered lime, would, by a slow process, be removed, and thrown up to the surface. This supposition is not imaginary, for in the field in which cinders had been spread out only half a year before, Mr. Darwin actually saw the castings of the worms heaped on the smaller fragments. Nor is the agency so trivial as it, at first, might be thought; the great number of earth-worms (as every one must be aware, who has ever dug in a grass-field) making up for the insignificant quantity of work each performs.

On the above hypothesis, the great advantage of old pasture land, which farmers are always particularly averse from breaking up, is ex-

plained; for the worms must require a considerable length of time to prepare a thick stratum of mould, by thoroughly mingling the original constituent parts of the soil, as well as the manures added by man. In the peaty field, in fifteen years, about three inches and a half had been well digested. It is probable, however, that the process is continued, though at a slow rate, to a much greater depth; for as often as a worm is compelled by dry weather, or any other cause, to descend deep, it must bring to the surface, when it empties the contents of its body, a few particles of earth. The author observed, that the digestive process of animals is a geological power which acts in another sphere on a greater scale. In recent coral formations, the quantity of stone converted into the most impalpable mud, by the excavations of boring shells and of nereidous animals, is very great. Numerous large fishes (of the genus *Sparus*) likewise subsist by browsing on the living branches of coral. Mr. Darwin believes, that a large portion of the chalk of Europe was produced from coral, by the digestive action of marine animals, in the same manner as mould has been prepared by the earth-worm on disintegrated rock. The author concluded by remarking, that it is probable that every particle of earth in old pasture land has passed through the intestines of worms, and hence, that in some senses, the term "animal mould" would be more appropriate than "vegetable mould." The agriculturist in ploughing the ground follows a method strictly natural; and he only imitates in a rude manner, without being able either to bury the pebbles or to sift the fine from the coarse soil, the work which nature is daily performing by the agency of the earth-worm.*

Lond. & Edin. Philos. Mag.

Report to the Royal Geographical Society, of an expedition in the interior of Africa.

A very full meeting of members was held on Monday evening, for the purpose of hearing the report of Captain Alexander, of his late expedition in the interior of Central Africa, directed towards the north-west coast, and the Damhara country. This expedition, originating with the society, by whom the expenses were paid, with the assistance of a grant from government, was delayed some time, till the termination of the Caffre war; but in September, 1836, Captain Alexander started on his journey, from which he returned home to the Cape on the 20th

* Since the paper was read, Mr. Darwin has received from Staffordshire the two following statements:—1. In the spring of 1835 a boggy field was so thickly covered with sand that the surface appeared of a red colour; but the sand is now overlaid by three-quarters of an inch of soil. 2. About eighty years ago a field was manured with marl; and it has been since ploughed, but it is not known at what exact period. An imperfect layer of the marl now exists at a depth, very carefully measured from the surface, of twelve inches in some places, and fourteen in others, the difference corresponding to the top and hollows of the ridges or butts. It is certain that the marl was buried before the field was ploughed, because the fragments are not scattered through the soil, but constitute a layer, which is horizontal, and therefore not parallel to the undulations of the ploughed surface. No plough, moreover, could reach the marl in its present position, as the furrows in this neighbourhood are never more than eight inches in depth. In the above paper it is shown, that three inches and a half of mould had been accumulated in fifteen years; and in this case, within eighty years (that is, on the supposition, rendered probable from the agricultural state of this part of the country, that the field had never before been marled) the earthworms have covered the marl with a bed of earth averaging thirteen inches in thickness.

September, 1837. During this period, he had traversed an extent of 4000 miles, of which 2000 was by walking, 1000 by horses, and 1000 on the backs of oxen. With the exception of four or five German missionaries, the whole country was new to Europeans for the distance of upwards of 1000 miles. Although the zoology of South Africa is very well known, Mr. Ogilby has recognised in the collection of mammalia, made by the expedition, many new species; some fine new species were contained amongst the birds; and the *hortus siccus*, placed in the hands of Dr. Lindley, contained several new and interesting species of plants, the seeds of many of which had been sown in the gardens of the Horticultural Society. The paper was replete with the most interesting details relative to the journey, many of which were highly complimentary to missionary exertion in advancing the cause of Christianity and civilization, through the means of the missionaries, whose services were on many occasions highly advantageous to the expedition. The tribes visited were the Namacquas, Bushmen, and two great nations of the plain and hill of Damharas, all of whom showed a friendly spirit to the members of the expedition, and exhibited a wish for further intercourse with Europeans. The two latter are negroes, partaking of all their marked characters, and beyond them resides a nation of red men, whom, however, it was found impossible to visit, on account of a war which was raging between the Damharas. From a female belonging to the hill of Damharas, he purchased, for two cotton handkerchiefs and two strings of beads, a little boy about seven years of age, who was in a half-starved condition, and employed in hunting lizards for food; and the appearance of this singular juvenile native in the room, along with a great variety of their domestic and warlike implements, excited considerable curiosity and attention. At different periods, the expedition suffered much for want of water, of which they were, at one period, destitute for nearly three days, with the thermometer upwards of 100 degrees in the shade, and losing several of their oxen, sheep, and dogs; and at one time ran so short of food, at to be compelled to eat leather. On the coast, they also discovered several points affording good accommodation for vessels, and through which, a beneficial intercourse might be carried on with the interior. Near the mouth of the Orange river, he discovered large quantities of copper ore, a sample of which had been analysed by Sir John Herschel, at the Cape, and found to contain 75 per cent. of copper, which was also easily accessible, and might either be smelted with Orange river wood, or carried up the river on rafts. The whole of this interesting statement will be published in the next number of the society's "Transactions." Mining Rev.

Geology of Bretagne.

A remarkably accurate and detailed memoir has been sent to the French Academy of Sciences, by M. Paillette, concerning the geology of the western part of the province of Bretagne. This gentleman, having held an official situation in the mines of Poullaouën and Huelgoat, has profited by the opportunities thus afforded him to a great extent, and given the most exact mineral topography of several cantons of complicated structure, with a fidelity and patience which will prove of much benefit to science. Besides the memoir, there are four excellent geological maps,

laid down with the utmost precision, and one of the conclusions to which M. Paillette has been led is, that all rocks of igneous origin have accidentally modified the sedimentary soils, according to circumstances which are unknown. The modifications produced by granite are a crystalline appearance, a development of the characteristics of talc, and the formation of garnets, staurotides; and those occasioned by porphyry are generally simple induration, sonorousness, and feldspathic injections. To this memoir M. Paillette has added a series of the most ingenious experiments, by which he wishes to prove the agency of electro-chemical phenomena in the daily formation of minerals in the different veins of Bretagne, and the Academy have requested him to continue his observations, in the full persuasion that they may lead to good results.

Mining Journal.

Singular Discovery of a Subterranean River.

A singular discovery was made in Blaen-y-nant lead mines, near Mold, Flintshire, a few days ago. The workmen at the end of one of the levels were surprised, and obliged to run for their lives, in consequence of an immense rush of water suddenly bursting in upon them. After three days the water totally disappeared; and, on cautiously proceeding to the place, they found an opening of about four inches diameter, through which the water had issued. Hearing a sound as of a heavy run of water inside, they enlarged the aperture so as to admit of their passing through, and found that it was the bed of a subterraneous river, which in all probability affords the principal supply to the far-famed St. Winifred's Well, at Holywell, from which it is distant about twelve miles. The stream being then shallow, they explored it about sixty yards down, and were astonished to find several large caverns to the right and left, from the roofs and sides of which were suspended numerous and beautiful specimens of white spar or stalactites. The company are in high spirits, these appearances being considered favourable for a large lodgment of ore.—*Shrewsbury Chronicle.* Ibid.

Mechanism of the Motion of Glaciers.

Mr. Mallet, at the British Association, made it evident that many phenomena of these singular masses had been hitherto overlooked; and although described by many eminent observers, no solution had been given to the question of their movement but that of their weight, which he showed could have only a partial operation, as they often rest on rugged beds, and these not always of much inclination. He proposed a very ingenious explanation of their movement by means of hydrostatic pressure, arising from the fact of the lower part of the glacier being of a higher temperature than the upper: this causes a melting of the under part, and a consequent raising of the mass in a perpendicular direction to the earth's surface, while its descent was at right angles to the inclined surface: a progressive motion downwards ensues, following the law of the resolution of forces. He then spoke of certain causes of the rents and fissures in glaciers, these being often convex downwards, owing to the operation taking place in the middle part of the mass, which descends soonest, while the whole is held in its place by the upper and lower extremities: also tubular fissures are formed by blocks of stone

sinking by degrees in the glacier, owing to their higher temperature gradually melting the surrounding ice. He then alluded to the singular accumulations of detritus on the glaciers, which are locally termed *moraine*, and are formed by *éboulemens* in winter and covered by the snow. These he found to assume linear directions parallel to the axis of the glacier; and, from the regularity of their arrangements, he conceived it possible to discover the site of old glaciers from the moraine which had remained on the ground after their destruction. Analyst.

On the Floating Masses of Fucus occurring near the Cape Verd Islands.

M. Kunth lately presented to the Academy of Sciences of Paris, in the name of M. Meyen of Berlin, a specimen of the *Sargassum natans* (Fucus natans, Linn.) brought from the celebrated *Mar de Sargasso*, near the Cape Verd Islands. M. Kunth remarked, that this individual, like all the others observed by M. Meyen in these latitudes, does not present the slightest trace of a point of attachment. It was therefore never attached to rocks or to any other supporting body at any period of its growth, but must have been developed floating on the surface of the sea. The opinion generally adopted by voyagers, that these plants have been torn from their original situations by the waves, and collected by currents in the Mar de Saragasso, appears to M. Meyen to be inadmissible; and he is inclined to believe that they have been produced at the place where they are observed. The same naturalist maintains that such individuals formed at the surface of the water never exhibit fructification. Edin. New Philos. Jour.

Mechanics' Register.

Girard College for Orphans.

As this is an Institution in which mechanics have a deep interest, and one to the completion of which all must look forward with great anxiety, the following description of the main building and of the state of the works at the present time, by the able architect, Thomas U. Walter, Esq. cannot fail to be acceptable to our readers. Com. Pub.

Description of the main Building of the Girard College for Orphans.

By Thomas U. Walter, *Architect.*

The Girard College is situated about one and a half miles northwest of the centre of the City, on a tract of land containing forty-five acres; the whole of which was appropriated by Mr. Girard exclusively to the purposes of the institution.

The main building, which is the subject of this description, is composed in the Corinthian order of Grecian architecture; it covers a space of 184 by 243 feet, and consists of an *octastyle*, peripteral superstructure resting upon a basement of eight feet in height composed entirely of steps extending around the whole edifice; by which a pyramidal appearance is given to the substruction, and a means of approach to the porticoes afforded from every side. The dimensions of the stylobate (or platform on which the columns stand,) are 159 feet on the fronts by 217 feet on the flanks, and the cell, or body of the building, measures 111 feet by 169 feet 2 inches. The whole height, from the ground to the apex of the roof, is 100 feet.

The columns are thirty-four in number; the diameter of the shaft at the top of the base is six feet, and at the bottom of the capital five feet; the height of the capital is eight feet six inches, and its width, from the extreme corners of the abacus, nine feet; the whole height of the column, including capital and base, is fifty-five feet.

The entablature is sixteen feet three inches high, and the greatest projection of the cornice, from the face of the frieze, is four feet nine inches; the elevation of the pediment is twenty feet five inches, being one-ninth of the span.

The capitals of the columns are proportioned from those of the Monument of Lysicrates at Athens; they are divided in height into four courses, —the first embraces the water leaf, and consists of a single stone of seventeen inches in thickness;—the second course is also composed of a single stone, the height of which is two feet ten inches,—the annular row of acanthus leaves occupies the whole of this course;—the third division of the capital embraces the volutes and cauliculi,—this course, which is likewise two feet ten inches in height, is composed of two pieces, having the vertical joint between the cauliculi on two opposite faces;—the fourth, or upper course, being the abacus, is one foot five inches in height.

The ceiling of the portico will be formed by beams resting on the tenia, and extending from the cell of the building to the colonnade opposite to each column; the spaces between the beams will be filled in with rich lacunaria.

The corners of the building are finished with massive antæ, having bases and capitals composed upon the principles of Grecian architecture.

The flanks of the cell are pierced with windows, which are ornamented with the Greek antæ, surmounted with architraves and cornices.

The doors of entrance are in the centre of the north and south fronts; they are each sixteen feet wide in the clear by thirty-two feet high; their outside finish consists of antepagmenta, of two feet seven inches wide, the supercilium of which is surmounted with a frieze and cornice;—the cornice is supported by rich consoles, of six and a half feet in height, and the cymatium is ornamented with sculptured honeysuckles.

The exterior of the whole structure will be composed of fine white marble, slightly tinted with blue.

The vestibules, which are approached by means of the doors at each end of the building, are ornamented with marble antæ, columns, and entablature, of the Greek Ionic order, which support a vaulted ceiling, consisting of eliptical groin arches, enriched with frets, guilloches, and lucunaria; the columns, which are sixteen in number, will each be composed of a single piece of marble;—proportions of the order are from the Temple on the Illusus at Athens.

The lobbies in the second story are directly over the vestibules, and occupy the same space. The columns in this story, which are also sixteen in number, will be composed in the simplest form of Corinthian, or foliated, architecture, proportioned from those of the Tower of Andronicus Cyrrhestes at Athens; the entablature will be surmounted with groin arches, similar to those in the vestibules, the soffits of which will be enriched with lacunaria.

The stairways will all be composed of marble; they will be constructed in the four corners of the building, each occupying a space of twenty-two by twenty-six feet, extending the whole height of the edifice; these openings

will each be crowned with a pendentive parabolic dome, surmounted with a skylight of ten feet in diameter—the height of the skylight from the floor will be eighty feet.

The building is three stories in height; each of which is twenty-five feet from floor to floor: there are four rooms of fifty feet square in each story. Those of the first and second stories, are vaulted with groin arches; and those of the third story, with domes supported on pendentives, which spring from the corners of the rooms at the floor, and assume the form of a circle on the horizontal section at the height of nineteen feet. These rooms are lighted by means of skylights of sixteen feet in diameter. All the domes are terminated below the plane of the roof, and skylights are designed to project but one foot above it, so as not to interfere with the character of the architecture.

The whole building will be warmed by means of furnaces, placed in the cellar; and every apartment will be ventilated upon philosophical principles.

Report of the Present state of the Work.

The marble work of the cell of the centre building has been raised about ten feet during the past year, making its present height above the ground about sixty feet.

All the bands and ties for resisting the lateral pressure of the arches over the second story rooms, are firmly fixed in the walls, and the centres are completed, and prepared to receive the brick work—all therefore that remains to be done to complete this story, is simply the construction of these arches, and the setting of the marble in the lobbies, which will consequently be the first work of the ensuing season.

We had expected to finish all the second story arches during the past summer; but the unusual severity of the previous winter, and the backwardness of the spring, put it out of our power to advance with this part of the work so rapidly as we had anticipated. We have, however, been actively employed on other parts of the buildings; having accomplished, in the aggregate, at least one-third more during the past year, than in any previous season since the commencement of the work.

The easternmost *out building* is now under roof, and the carpenters are engaged in finishing the interior.

The out building nearest the college requires about ten feet in height of marble work to complete the exterior, the greater part of which will be wrought during the winter, so as to enable us to put this building under roof early in the ensuing season:—both of these out buildings will be completed during the present year, and may be occupied as soon as they are finished, without interfering with the rest of the work.

At the commencement of the last season, there were *four hundred and thirty thousand bricks* remaining on the ground from the previous year; since which time, there have been delivered at the works, one million five hundred and ninety thousand, making in all, two millions and twenty thousand; of which *one million five hundred and twenty thousand* have been used in the buildings, leaving about *five hundred thousand bricks* now on the ground to commence operations with in the spring.

The amount of marble work done during the past season is almost

double that of any previous year; and the character of the workmanship still merits the highest commendation.

The execution of the carving of the exterior capitals continues to give entire satisfaction.

Several of the large bases and column blocks are now in the hands of the workmen; and it is intended to continue with this part of the work during the winter, so as to enable us to proceed at the opening of the ensuing season, with the eastern portico, the two south columns of which have already been commenced.

The columns, antæ and entablature for the lobbies in the second story are in progress of execution; there are now completed, for this part of the work, ten capitals, fourteen bases, seven shafts of columns, and a considerable quantity of the architrave and antæ; the rest will be finished in the course of three or four months.

All the marble used in the buildings during the past year, amounts to 40,588 superficial feet, and there are now on the ground 12,338 feet of finished work, 2,173 feet of sawed material, and 3,950 cubic feet in the rough.

It is a source of great satisfaction to be able to state, that all our apprehensions in regard to the supply of marble are relieved, as the contractors have begun to work another quarry, which will enable us to obtain, without difficulty, all that may be required for the completion of the college, and all the buildings connected with it.

The whole amount of marble delivered during the past year, amounts to 39,722 cubic feet;—more than one hundred column blocks have already been quarried, and all that will be required for the exterior portico can be procured, if necessary, during the ensuing season.

The expenditures, from December 23, 1835, to December 31, 1836, amount to $153,949 74.

I have estimated the value of the materials and workmanship now on the ground, which have not yet been used in the building, at about $68,000, nearly all of which will be used during the present year.

I am happy to have it in my power to say, that thus far nothing has been omitted that would tend to give permanency and durability to the buildings;—the plans have been correctly executed, and the various departments of the work have all been faithfully and judiciously managed, by the gentlemen whom you have appointed over the several mechanical branches.

The propriety of commencing the two western out buildings in the spring, is a subject to which I would respectfully request your early consideration;—the foundations of these buildings may be laid, and the marble work constructed as high as the basement during the ensuing season, without interfering with the other work; I therefore venture to suggest, that arrangements be made for extending the work, so as to embrace these two buildings.

Girard College, THOMAS U. WALTER,
January 2nd. 1837. *Architect.*

Paving Streets with Wood.

At a meeting of the Marylebone Vestry, held Aug. 26, 1837, "Mr. Stead was introduced to the Vestry to state his plan for paving Oxford Street with wood. He said that the plan had been approved of by Sir

George Rennie, Mr. G. Rennie, Mr. Gibbs, Mr. Braithwaite and other engineers, and that they had expressed their surprise that it had not been adopted in London. It had been found to answer exceedingly well in St. Petersburg and New York, and possessed great advantages over the usual mode of paving, inasmuch as the cost would be less, the durability greater, and it would be unaccompanied by the noise which the present system is of necessity subjected to. The plan had been seen in operation in the Netherlands by Mr. Rennie, who highly approved of it. Mr. Stead was requested to furnish the Vestry with a written statement of his plan, which he consented to do."—(*Morn. Chron.*, Aug. 28.) It appears that this mode of paving has been tried for about a year and a half past in the Broadway, New York, and found to answer very well. The wood employed was that of the Robínia Pseùd-Acàcia, cut into hexagonal pieces, about 1 foot long and 10 inches across. Another experiment is now being made, with square pieces of pine and other woods, with boards placed under them, where the ground is not firm. —(*Newsp.*) Architec. Mag.

We may add to this statement that Chesnut street, Philadelphia, from Fourth to Fifth street (now ycleped Bank Place) has been paved in excellent style, with polygona. G.

The Steam Ship Sea Horse.

We have been gratified with a view of, and trip on board, the beautiful and powerful steam ship *Seahorse*, which arrived here, on Wednesday, from Dundee, after a run of twenty-five hours, against a strong head wind. On going on board, the visitor is struck with the spacious deck and splendid saloon, as well as the general fittings and arrangements both for comfort and safety. But that which most strongly attracts the attention of the scientific observer, is the beautiful manner in which the engines perform their functions; indeed the motion is so perfectly smooth, that if you were not aware of the fact, you would scarcely believe that the engines were at work. The reason why these engines are superior to the generality of marine engines, is the application of Mr. Samuel Hall's patent condensers, and as many persons may not be acquainted with the nature and merits of Mr. Hall's invention, it may not be amiss to give a few particulars on this point, particularly as it bears so much on the safety of the boilers, and the wear and tear of the engines. First: the boilers are supplied with pure distilled water, which prevents the usual saline deposit and corrosion of the boiler. Second: as no deposit or incrustation can possibly take place, the transmission of heat to the water is more uniform, the boiler-plates are prevented from burning, and consequently a saving of fuel is the result. Third: as the steam is condensed through the medium of copper pipes (the steam being prevented from coming in contact with the jet of cold water, as in the common mode,) the air-pump has less work to perform, and additional power is thereby gained. Fourth: muddy salt water is entirely shut out from the interior of the engine, and an immense saving is effected in the wear and tear of the moving parts, as the valves, &c.; and from the muddy quality of the river Humber, it is an invaluable discovery for steamers connected with Hull. In conclusion we have but one regret, which is, that from the great width of the *Seahorse*, she will

not be able to enter any of the docks, being many feet wider than any of the dock locks, but trust that the dock company will not be long before they see the necessity of giving increased accommodation.—*Hull Advertiser.*

Mining Journal.

Steam Engines within the Borough of Birmingham.

By a report made to the Birmingham Philosophical Institution, October, 1836, it appears that 169 steam-engines had been erected from 1780 to that period, of which 17 had been erected in 1834, and 22 in 1835. The total horse power was equal to 2700 horses. Within the same period engines equal to 162 horses' power had become void, or removed. Of those erected and estimated in horse power, 275 were used for grinding flour; 1770 for working metals; 279 for pumping water; 87 for glass grinding; 97 for working wood; 44 for paper making and glazing; 37 for grinding clay; 61 for grinding colours and chemicals; and 50 for sundry purposes. The estimated consumption of coals is 216 tons per day; estimated number of persons employed 4000 males, and 1300 females; and the estimated amount of power hired out, equal to 450 horses. These estimates are confined to engines within the borough, and, of course, do not include the great Soho works of Bolton and Watt. Of the 1770 horse power employed in working metals, it is computed that 162 is used by iron founders, first applied in 1788; 570 in rolling copper, brass, and other metals, first applied in 1790; 150 in drawing wire, first applied in 1808; 201 in iron forges, and wrought iron mills, first applied in 1810; 74 in nail cutting, first applied in 1813; 104 in screw making, first applied in 1819; and 34 in drawing metal tubes, first applied in 1822.—*Railway Mag.*

Ibid.

Preservation of Wood from Decay.

The wood which is used in the salt mines of Hallein, in Germany, is preserved from decay by being saturated in strong brine. This discovery was made by observing, that the timber which supports the ceiling of the galleries, upon being exposed to the action of the salt earth, became harder and harder, and scarcely ever after liable to decay. From this fact it is supposed that the *bichloride of sodium* is as efficacious in preserving vegetable matter from the destroying energies of the dry-rot, as the *bichloride of mercury.* Certain it is, that the former plan is preferable, to the latter, so far as it is free from the injurious powers which the mercury presents to the workman, when the article which is so prepared is used in manufactories. The former is well worthy of trial, and if found to possess the qualities which it is presumed it contains, its economy and simplicity will place it within the reach of every individual.

Ibid.

Post Office Revenue of England.

A return prepared for the House of Lords, on motion of the Duke of Richmond:—shews that there has been a gradual increase from 1827 to 1836.

	Gross Revenue.	Net Revenue.
In 1827 the amount was	£2,278,412	£1,484,164.
1836 " " "	2,461,805	1,645,835.

Ibid.

LUNAR OCCULTATIONS FOR PHILADELPHIA, JULY 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
3	12	40	Im. A' Scorpii	,5,	17°	62°
3	14	9	Em.		325	18
7	11	8	Im. 58 ω Sagittarii	,6,	126	107
7	12	22	Em.		263	258
7	13	16	Im. 60 α Sagittarii	,5,6,	161	164
7	14	6	Em.		238	250
15	14	23	Im. ζ Arietis	,5,	163	109
15	15	5	Em.		254	199

Meteorological Observations for January 1838.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer, Sun rise.	Barometer, 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	33	42	30.13	30.30	E.	Moderate.		Cloudy—clear.
☾	2	30	35	20	20	W.	do.		Cloudy—do.
	3	34	45	10	15	S.W.	do.		Cloudy—lightly cloudy.
	4	36	55	5	6	S.	do.		Clear—do.
	5	46	62	29.85	29 80	S.	Brisk.		Partially cloudy—cloudy.
	6	39	48	30.10	30.25	W.	Moderate.		Clear—do.
	7	32	53	10	29.96	NW.S.	do.		Clear—lightly cloody.
	8	49	38	29.74	90	SW.	do.	.05	Cloudy—rain.
	9	29	33	63	60	E.	do.	.03	Cloudy—drizzle.
☉	10	28	32	30.00	30.00	W.	do		Clear—do.
	11	17	21	23	23	NW.	do.		Clear—do.
	12	19	33	35	35	W.	do.		Clear—do.
	13	29	42	25	25	W.S.	do.		Clear—do.
	14	29	46	29.93	29.93	S.	do.	.05	Partially cloudy—rain.
	15	42	43	63	75	W.	Brisk.		Partially cloudy—do. do.
	16	28	50	30.00	30.00	SW.	Moderate.		Clear—do.
	17	43	55	84	29.85	SW.S.	Brisk.		Partially cloudy—do. do.
☽	18	48	60	85	85	SW.	Moderate.		Heavy fog—lightly cloudy.
	19	48	43	50	40	SW.W.	Brisk.		Cloudy—do.
	20	23	32	30.10	30.15	W.	Moderate.		Clear—do.
	21	24	29	10	5	W.	do.		Cloudy—do.
	22	20	30	20	20	NE.E.	do.		Partially cloudy—clear.
	23	20	37	20	20	NE.	do.		Clear—do.
	24	24	43	15	20	E.S.	do.		Clear—do.
⊗	25	36	40	20	20	E.	do.		Clear—do.
	26	42	47	29.85	29.85	SW.W.	do.	.43	Rain—clear.
	27	36	38	30. 5	90	NE.SE.	do.	.42	Cloudy—rain.
	28	36	42	29-50	50	W.	Blustering.		Cloudy—flying clouds.
	29	23	28	85	80	W.	do.		Partially cloudy—do. do.
	30	16	23	30.00	30.00	W.	Moderate.		Clear—flying clouds.
	31	12	23	16	16	W.	do.		Clear—do.
	Mean	31.32	40.26	30.00	30.00			.98	

	Thermometer.	Barometer.
Maximum height during the month.	62.00 on 5th.	30.35 on 12th,
Minimum do.	12.00 on 31st.	29.40 on 19th.
Mean do.	35.78	30

JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

JUNE, 1838.

Practical and Theoretical Mechanics and Chemistry.

Some researches as to Lime and Mortars. By M. Courtois, *Engineer of Roads and Bridges.** *(From the Annales des Ponts et Chaussées, Paris,* 1834.) *Translated from the French by J. G. Totten, Lt. Col. of Eng. and Brevet Col. United States Army.*

(Continued from page 321.)

The art of making good mortars is every day becoming better appreciated, from the influence it exercises in the economy and on the duration of constructions. If, in every great work, the constructors would make known the researches they have instituted, and the conclusions to which they have been led, we should soon know the resources presented by each locality, and be every where able, progressively, to improve the manufacture of mortars.

Having had occasion at various times to make numerous essays on lime and hydraulic mortars, and on the means of making them economically, I think I am fulfilling a duty in presenting a summary of the principal results.

My investigations have had particularly in view the qualities of the mixtures, or combinations of lime and clay, comprised between hydraulic lime and cement; but in order not to leave any void in the scale of various proportions to be tried, I thought it best to try all combinations possible with 100 parts of the mixture.

I shall examine successively,

1st. The elements of these combinations, viz. limestones, clayey earth, and marl; I shall give the analysis of each, and examine their respective properties.

2nd. The combinations made with the most simple proportions, and which, for greater clearness in the tables, I shall call combinations of the first order: these will be mixtures of 1, 2, 3, 4, &c., parts of clay, with 9, 8, 7, 6, &c., parts of lime.

3rd. The combinations of the second order, or hydraulic pastes, result-

*The object of these researches was to give to fat lime the hydraulic quality necessary, and to mortars a determinate resistance, at a small expense.

ing from the preceding compounds, mixed, in their turn, with various proportions of fat lime.

4th. Combinations of the third order, or mortars resulting from the mixture of the preceding hydraulic pastes with twice their volume of sand.

I shall give, moreover, the experiments made with each hydraulic paste, and each mortar, to determine the hardness, after various periods of immersion, and to determine at the same time the resistance to rupture of each of the combinations.

I shall afterward examine the natural substances analogous to these several artificial combinations: indicating how they may be known, and showing the abundance of these hydraulic substances in nature.

Following my observations on the resistance of artificial hydraulic pastes, I shall give analogous experiments applied to the comparison of a great number of natural hydraulic pastes, and mortars made of these pastes.

Article xx.—*Artificial combinations of Lime and Clay.*

Lime. Without going into details as to the chemical properties of lime, it may suffice to say that this substance forms the base of limestones, and gypsum, or plaster of Paris; and that it combines, at a high temperature, with silex, forming what is called a silicate of lime. In the humid way, it appears to combine with clay, either crude or calcined, affording a hydro-silicate with a base of lime and alumine.

Lime, as it is used in making mortars, is obtained by the calcination of limestones, which are carbonates or subcarbonates more or less pure, found in all the formations; it is obtained also from some animal productions, as shells of oysters, and other shells.

The effect of calcination is to drive out the water and carbonic acid. By breaking the stone into pieces about one and a half inch square and passing a current of steam through the ignited mass, a cubic metre (35.32 cubic feet) of lime stone may be converted into lime, in a kiln with a continual fire, by burning about seven cubic feet of sea-coal:* in cold and moist seasons the consumption of coal is augmented; and amounts, sometimes, to a third of the volume of the stone.

If the limestone be argillaceous, the fire should be managed cautiously, and be less violent than to calcine a nearly pure carbonate of lime; for when the fire is too high, the lime and clay fuse, and give a vitreous matter inert, or without causticity, which is a double silicate of lime and alumine.

Whenever a piece of limestone is cooled before the calcination is completed, it becomes necessary to wet it before putting it again in the kiln; without this precaution, it would be very difficult to reduce it completely to lime.

After calcination, lime has a great affinity for water, and augments in volume, by absorbing it. If a certain quantity of water be thrown on lime

* On the canal of Ardennes, where I caused large quantities of lime to be burned, the lime burners threw into the kiln one measure of sea-coal to five, six and even seven measures of limestone; it should be observed, however, that the stone was a chlorite-chalk, easier to convert into lime than limestones generally.

At Theil in the department of Ardèche, whence the best hydraulic lime that I know of is derived, they consume but one sixth of a measure of sea-coal in burning one measure of lime. Author.

recently calcined, it heats, splits open, and is reduced to powder, or paste, according to the quantity of water absorbed; during this operation, a little water is carried off by the heat; but, when the lime is obtained from a nearly pure limestone, the volume of paste after slaking, is, sensibly, equal to the volume of water absorbed.*

Clay. Clays are composed of silex and alumine in variable proportions, often mixed with quartzose sand, oxide of iron, magnesia and lime. When the clays contain no sand, they are fine and soft to the touch; and form with water an unctuous paste susceptible of being moulded into any form.

The clays which I chiefly used are those of which the analyses are given in columns 1, 2, 3, and 4, of table LVII.

Combinations of Lime and Clay. If crude clay be mixed with various proportions of lime, pastes are formed which have much more consistence than clay alone: this paste, put under water, acquires at the end of three days, a certain hardness which it preserves, afterward, indefinitely; it attains its maximum of resistance, when one part of lime is mixed with nine parts of clay; this paste, after three days, resists the pressure of the thumb.

When a mixture of lime and clay, exposed for some days to the air, has lost a part of its water, without having been dried too rapidly, it may be afterward immersed without sustaining any alteration, provided the volume of lime be not greater than one third that of the clay; the proportion of lime might be less but should not be greater. A mortar of this sort might be used in the construction of cisterns, reservoirs, and other works, where an insoluble, rather than a strong, mortar is needed. I regret not being able to state the actual resistance of mortars made of lime and crude clay, but at the period I was occupied with these first researches, the hardening under water was the property to which I confined my attention.

The quality of augmenting the resistance of lime, which crude clay possesses appears to have been known for a long time in *Champagne*, where all the wooden houses are covered, exteriorly, with a plaster composed of lime and a white argillaceous and calcareous earth. The floors are also made with a plaster of the same nature, and when not dried too rapidly, they resist perfectly.

This property explains how it is that sand, mixed with a certain quantity of crude clay, forms a mortar with lime, which acquires a degree of hardness under water that does not, however, increase after some days.†

If fat lime, and clay containing little or no calcareous matter, be mixed, 1, 2, 3, 4, 5, 6, 7, 8 and 9, parts of clay, respectively, with 9, 8, 7, 6, 5, 4, 3, 2 and 1 parts of lime, a series of eleven compounds will be formed, of which the first term will be pure lime, and the last, pure clay; if the last ten compounds be calcined, substances will result possessing the properties about to be described.

*In a considerable number of experiments that I had occasion to make in 1823, I always obtained the above relation between the bulk of the slaked lime, and the absorbed water; the quantities of lime on which I experimented, varied from three and a half to ten and a half cubic feet. Au.

†The sands now referred to must not be confounded with those which contain, in their interstices, mud or slime more or less charged with animal or vegetable matter; when this last kind of sand is used, the lime forms, with the animal or vegetable substance, a soap, more or less soluble, which opposes the hardening of the mortars. Sands of this kind, if not washed free from these matters before they are used, always give very bad results. Author.

Hydraulic lime. The first two mixtures will give hydraulic lime, as Mr. Vicat has long since made known.

The lime of the first compound is moderately hydraulic, hardens slowly in water, and takes, in time, the consistence of hard soap.

The lime of the second, acquires, after three days immersion, the hardness of chalk: after 20 days immersion, it permits a stem 0.08 inch in diameter, loaded with 2.20 lbs. falling from a height of two inches, to penetrate 0.12 inch: and after two months immersion, it shows no sensible impression from the shock of the stem.

On mixing the lime of the first two compounds with fat lime, they divide with this last their hydraulic properties; but these properties decrease quite rapidly. Hydraulic lime containing 0.20 of clay, mixed with an equal volume of fat lime, acquires at the end of two months the hardness of lime containing 0.10 of clay. By this kind of mixture, the energy of lime, slightly hydraulic, is sensibly augmented; a lime which would take only a feeble consistence when alone in water, acquired, by mixture with one quarter, or only one fifth, of very hydraulic lime, the properties of limes that are moderately hydraulic.

Lime-cement. The four following compounds, containing 3, 4, 5, and 6 parts of clay united with 7, 6, 5, and 4 parts of lime, give, by calcination, substances that slake slowly, disengaging but little heat; but when pulverized and made into paste, increase in volume, and acquire, promptly, great hardness under water. Their augmentation of volume continues some time after they have commenced hardening; for if a glass be filled therewith, it splits in all directions, but the cracks do not become apparent till a month or two after it has acquired a hardness equal to that of chalk. This augmentation of volume, which breaks the glass in which the experiment is made, is however but slight; for when the paste is made into the form of bricks, it is rare that it presents fissures. Each of these compounds mixed with an equal volume of sand, and even with a double volume, gives a hydraulic mortar which, after six hours immersion, resists the pressure of the thumb: and after eight days, perfectly resists the shock of the stem above spoken of.

Besides the properties mentioned, the same compounds communicate to fat lime their hydraulic qualities; imparting all the energy of lime eminently hydraulic.

If 1, 2, 3, 4, 5, 6, 7, 8 and 9 parts of the powder of each of these compounds be taken, and mixed respectively with 9, 8, 7, 6, 5, 4, 3, 2 and 1 parts of fat lime, different degrees of hydraulic property will be given to the latter: with five parts of powder, a lime eminently hydraulic will be obtained: two parts of powder will suffice to make eight parts of lime hydraulic; but, one part of powder will communicate only a feeble degree of hydraulic property to nine parts of lime; after eight days' immersion, this last mixture will hardly have the consistence of moist soap.

If, an hour after the mixture, all the pastes made of the lime and powder, above mentioned, be immersed, they will set under water in six days for the least hydraulic; after that time, the hardest will resist the pressure of the thumb. Each of these pastes mixed with a volume of sand equal to the volume of paste at least, and to twice the volume of paste at most, will give a mortar which will harden in water a little less rapidly than the paste without the sand.

The compound of five parts of lime and five parts of clay is that which gives the most energetic powder.

According to the proportions of lime and powder, the paste is more or less gritty or more or less unctuous, but all harden in a short time after immersion: for example the powder derived from the compound of four parts of lime and six parts of clay gave results sensibly the same as those derived from a compound of six parts of lime and four parts of clay.

The compounds of which we have been speaking enjoy, therefore, the properties of lime and cement, at the same time. When mixed, alone, with sand, they serve to make mortars—acting, in this respect, like lime; when, on the other hand, they give hydraulic properties to lime, they, in that respect, act like cement: this double property has induced me to designate them by the term *lime-cement*.

Hydraulic Cement.—The terms of the series composed of 7, 8, and 9 parts of clay, respectively mixed with 3, 2 and 1 parts of lime, give, by calcination, substances that do not slake: their colour is more or less reddish, according to the greater or less quantity of oxide of iron in the clay. These matters being pulverized and made into paste, form a mortar, more or less meagre, which hardens under water in the space of ten days.

The powders of these compounds, mixed with various proportions of fat lime, give hydraulic pastes which harden under water in a few days.

These compounds being true cements, enjoying the property of hardening when alone under water, it seems convenient to designate them as *hydraulic cements* in order to distinguish them from *common cement* which, when alone, will take no consistence under water.

Common cement.—Clay, as has been long known, gives, by calcination and pulverization, a cement that being mixed with fat lime in various proportions, forms a mortar that hardens slowly under water, but which in time acquires a degree of hardness superior to that of hydraulic lime, either alone or mixed with sand, as we shall have occasion to show when on the subject of resistance to rupture of hydraulic paste and mortar.

Mode of mixing.—All the mixtures or combinations spoken of were made at the moment of slaking the lime*, or a short time afterwards.

When lime has been slaked for several days, the pastes and mortars split under water, take but little consistence, and seem to abandon their lime; which does not occur, or is much less sensible, when lime newly slaked is used: I content myself with stating the fact, without pretending to explain it.

When the lime is immersed while hot, an analogous effect is observed; but then it is caused by the swelling of a paste not saturated with water before the immersion.

The mixtures should, therefore, be made at the moment of slaking, but they should not be immersed for three or four hours afterward, if the volume is small, nor for twenty or thirty hours afterward when the bulk is considerable.

Mode of experimenting.—In the first experiments I had occasion to make, I mixed fat lime with a brick earth of which the analysis is given in the first column of table LVII.; this earth containing hardly $\frac{1}{10}$ of calcareous matter gave combinations possessing all the properties described above.

At this first period of the experiments—then less methodical than after-

* The slaking was always done by the ordinary process, that is to say by adding to the lime in a basin, the necessary quantity of water.—*Author.*

ward, I contented myself with putting into the glasses, volumes of paste occupying about a third of their capacity, and then pouring on water to fill the vessel. I subsequently measured the degree of advancement of the induration, by letting fall, from a height of two inches, a stem of iron $\frac{8}{100}$ of an inch in diameter, and loaded to weigh 2.2 lbs.

In a second series of experiments, I made use of argillaceous earth of which the analysis is given in the second column of the table LVII: this earth, as the analysis shows, contains nine per cent. of lime: it therefore gave pastes less resisting, and of a less prompt induration, than the preceding.

The volumes of paste were equal. To this end they were moulded in a hollow tin prism 1.8 inch long and 1.2 inch square: the substance thus moulded was, while still soft, forced out of the tin prism by a piece of wood of the same form and size, and placed at the bottom of a glass; each prism thus deposited at the bottom of a glass, remained half an hour exposed to the air and was then covered with water.

In mixing successively 9, 8, 7, 6, 5, 4, 3, 2, and 1 parts of the powder of the *ten combinations of the first order* with 1, 2, 3, 4, 5, 6, 7, 8, and 9 parts of fat lime, I obtained 100 combinations of the second order, or, in other words, one hundred different hydraulic pastes.

The figures of the two horizontal lines at the top of tables LIX. and LX., indicate the respective numbers, first, of the parts of the substances *a*, contained in the second column as combinations of the first order; second, of the parts of fat lime, which were mixed therewith to form the combinations of he second order.

The pastes of the same vertical column are, consequently, composed of the same number of parts of fat lime mixed successively with a certain number of parts of the several matters *a*, or combinations of the first order, mentioned in the second column of the table.

Hardening of Hydraulic Pastes.—To measure the degree of advancement of the induration of the several hydraulic pastes, I could not use the stem loaded with 2.2 lbs. of lead, because it would certainly have broken the prisms: I replaced it by another $\frac{48}{1000}$ of an inch in diameter, loaded with lead so as to weigh $\frac{2}{3}$ of a pound.

Fifteen days after the immersion, each prism, withdrawn from the water in which it had been immersed, was submitted to the shock of the stem just described, falling from the height of $\frac{8}{10}$ of an inch only; the number inscribed in each column of the table LIX, indicates the penetration for each prism.

Several prisms perfectly resisted the shock, and sustained no sensible penetration: others presented irregularities in their resistance without any apparent cause.

Two months after the immersion, the prisms were submitted to a second proof; the stem falling, then, from a height of $1\frac{8}{10}$ inch; the numbers expressive of the degree of penetration of the stem into each prism, are given in table LX.; as the effect of the shock should be double in the second proof what it was in the first, and as the degree of penetration had generally diminished, it results that in the space of forty days the resistance of all the hydraulic pastes was more than doubled.

After four months immersion, the stem, let fall from a height of $2\frac{4}{10}$ inches—the greatest height the instrument would allow, produced no sensible effect on the greater part of the prisms.

Resistance to rupture of hydraulic pastes.—At this period I thought it proper to measure the resistance to rupture. To obtain this resistance, I

operated with each hydraulic paste, on a prism 1.80 inch long, and 1.20 inch square, making use of an arrangement similar to that described by General Treussart in his work on mortars. Each prism passed through a small iron stirrup, and rested on two supports which were 1.20 inch apart; from the stirrup was suspended a scale-pan on which was placed, successively, greater and greater weights: that which caused the rupture was noted, and augmented by the weight of the stirrup and scale-pan, which was 12.10 lbs. The numbers indicating the weights that broke the prisms, are inserted in table LXI.

The results comprised in table LXI. present some anomalies, of which several were caused by voids that were found in a number of the prisms: others supported greater weights than was to be expected from their composition, without my being able to assign the cause.

The same table shows that lime moderately hydraulic, containing 0.10 of clay and 0.90 of lime, mixed in different proportions with fat lime, afforded prisms which supported from 29.0 lbs. to 66 lbs.

It also shows that very hydraulic lime, containing 0.20 of clay and 0.80 of lime, in the same circumstances, gave prisms that supported from 53 lbs. to 207 lbs.

That prisms of lime-cement mixed with different proportions of fat lime, supported from 53 lbs. to 440 lbs.

That prisms of hydraulic cement and fat lime, supported from 44 lbs. to 363 lbs.

That prisms of common cement and fat lime, sustained from 0.00 to 356 pounds.

A prism of common burnt brick, such as is used at *Rive-de-Gier*, having exactly the dimensions of the prisms of hydraulic paste, broke under a weight of 117 lbs.

Of the 100 prisms tried, 69 had strength superior to this well burned, but coarse grained, brick.

Resistance of mortars to rupture.—At the same time that the prisms of hydraulic paste were moulded, the same pastes were mixed with double the volume of sand, forming one hundred hydraulic compounds inserted in tables LIX, LX, and LXI. Combinations were thus formed of a third order, which we call mortars; these were moulded into prisms 4 inches in length by $1\frac{8}{10}$ inch square.

After four months immersion, the resistance to rupture of these mortar prisms was determined. To this end each prism was passed through a stirrup and made to rest on supports that were two inches apart: to the stirrup was appended a scale-pan in which weights were placed to cause the rupture: the weight which effected the rupture, increased by that of the scale-pan and stirrup, which was $12\frac{1}{10}$ lbs., was noted. The weights thus determined are inserted in table LXII.

These numbers are much weaker than might be expected from the resistances afforded by the hydraulic pastes (table LXI:) which deficiency in the resistances of these mortars, appears to be due to the quantity of sand, which was generally too great: in fact, *lime cements, and cements*, contain within themselves a certain quantity of matter not susceptible of slaking, and which, consequently, acts as sand: the portions of true hydraulic paste which should serve to bind together the sandy particles, were therefore in too small quantity in the greater number of the prisms.

I wished to leave the mortars immersed during at least one year, but time failed me.

A prism of common burnt brick, having exactly the dimensions of the prisms of mortar, broke under the weight of 240 lbs.

Of the 100 mortar prisms submitted to trial, there were but 5 that were superior to the brick prism.*

From what precedes, results the following classification of combinations, elementary in some sort, which may enter into the composition of mortar.†

1st. *Fat lime*—which does not contain clay, or in which the clay is less than the $\frac{1}{10}$.

2nd. *Hydraulic lime*—which contains that of $\frac{1}{5}$ of clay.

3rd. *Lime cement*—which contains from $\frac{1}{5}$ to $\frac{2}{5}$ of clay.

4th. *Hydraulic cement*—which contains from $\frac{2}{5}$ to $\frac{1}{10}$ of lime.

5th. *Common cement*—in which the lime is wanting, or exists in quantity less than $\frac{1}{10}$.

Article xxi.—*Natural Combinations of Lime and Clay.*

Limestones capable of affording hydraulic lime.—Lime, silex and alumine, the elements necessary to hydraulic lime, are substances that Nature affords in abundance in the secondary and tertiary formations: the crust of the globe is almost entirely formed of them: each of these substances alone, forms layers more or less thick, which often alternate with the others: this alternation is to be seen whenever, in the same formation, there is a change in the nature of the rock: thus, as is frequently seen, strata of clay, alternate with calcareous layers, and with strata of sand stone or free stone. When this happens it is rare that the stratum is entirely composed of the one substance; in the passage of the calcareous strata, for example, there are formed, first, calcareous strata containing a small quantity of clay, then, becoming more argillaceous, passing often to the state of marle, and at last, the clay is found almost alone, or without mixture of lime. When a succession of this nature is presented, it may be conceived not to be difficult to find a calcareous layer wherein the clay will exist in proportions suitable for hydraulic lime.

The preceding observation has often been useful to me in directing my search for natural hydraulic limes. In the Jura limestone formation (*formation Jurassique,*) for example, where such alternations are frequent, I have found hydraulic lime: 1st. near *Brabant* (Meuse,) in the oolitic beds which alternate with beds of clay: 2nd. near *Villers-le-Tourneur* (Ardennes,) in other oolitic layers, presenting the same alternations: 3rd. near Joinville (Haute-Maine.)

For a long time, a bed of gryphite lias, alternating with beds of clay, and which gives a lime slightly hydraulic, has been quarried near Lyons.

Near Macon, there exists a quarry of the same kind in the oolitic layers; the lime of Sury (Loire,) and that of Theil (Ardèche,) which are very hydraulic, are derived from some layers of lias found under analogous circumstances.

In the inferior layers of the chalk formation, where the same alternations are remarked, I very easily found hydraulic limes at different points on

* When on the subject of natural *lime-cements* and of *common cements*, I shall refer to mortars that supported, after four months, a load almost twice as great as the greatest inserted in the table.—*Author.*

† In almost all localities, Nature offers the materials proper to form the different elements of mortar, in abundance; as will be shown in the following article.—*Author.*

the limits of the formation, as Saint-Menehould, Rethel, and Vitry-le-Français.

In the tertiary formation, having noticed alternations of lime and clay near Hermonville (Maine,) near Valsery (Aisne) in the calcareous beds containing cerithiœ, and lastly, near Chateau-Thierry, in the strata of siliceous limestones, it was easy to point out the layers which it was proper to try, in searching for hydraulic lime.

The preceding observation is always true for the beds of the same formation; but it ceases to be exact at the point of passage of different formations. The chalk formation, for example, is often covered with the plastic clay which belongs to the tertiary: but these two layers appertain to two distinct formations; the first had existed for a long time before it was covered by the second; the calcareous matters not having been produced simultaneously, the two substances are simply juxtaposited, without alternation or mixture.

We may conclude, from what precedes, that whenever limestone is found alternating with clays or marls, one or several of the layers will give hydraulic lime. Five or six trials with small specimens will suffice to show which of the layers should be quarried.

I will terminate what relates to natural hydraulic limes by stating the process to which I submitted some of the limes, and the mortars into the composition of which they entered.

The experiments on the natural hydraulic pastes, and on the mortars made from them, were conducted under the same circumstances as the experiments mentioned in tables LXI and LXII, with the artificial combinations.

The prisms of hydraulic paste were $1\frac{8}{10}$ inch long and $1\frac{2}{10}$ inch square, and were placed on two supports which were $1\frac{8}{10}$ inch apart.

The prisms of mortar were four inches long and $1\frac{8}{10}$ inch square, and were placed on supports which were two inches apart.*

The same stirrup rested on the prism, and had suspended from it the scale pan, weighing, together with the stirrup, $12\frac{1}{10}$ lbs.

The lime derived from Theil (Ardèche) is the most powerfully hydraulic of any I have met with: it is obtained by burning a limestone of which the analysis will be found in the fourth column of table LVII.

A prism of this lime having exactly the same dimensions as those of the hydraulic pastes in table LXI, broke under a weight of 229lbs; its resistance, after four months immersion, was, consequently, double that of a brick of the same dimensions.

*Knowing the resistance E of a prism of matter having the dimensions of those of the hydraulic paste, it is easy to determine the resistance E′ of a prism of the same substance having the dimensions of the prisms of mortar; by using the formula $E = R\frac{ab^2}{c}$ in which a is the breadth of the prism, b its depth, and c the distance between the supports.

For other dimensions we have $E' = E\dfrac{\dfrac{a'(b'^2)}{c'}}{\dfrac{a(b^2)}{c}}$.

And in substituting for a, b, c and a', b', c' the above values, we find

$E' = 2.025$ E. AUTHOR.

In table LXIV, I have given the results of the proofs to which I submitted different prisms of mortars composed of Theil lime mixed with different quantities of sand: these mortars after one month broke under a weight varying from 59lbs. to 81lbs. Mortar composed of one part of lime and four parts of sand, broke under a weight of 59lbs., and that composed of one part of lime and one and a half part of sand, broke under a weight of 81lbs.

A prism of mortar composed of one part of Theil lime and two parts of sand, after four months immersion, broke under the weight of 469lbs.; the resistance of the mortar was, consequently, six times that of the same mortar one month old, and twice that of a brick.

In the environs of *Rine de Geir*, are the remains of a Roman aqueduct which conveyed a part of the waters of the Saint Etienne to Lyons; I extracted from these ruins a piece of mortar which appeared to be as hard as stone, and cut it carefully to the same dimensions as the prisms that had been tried: the prism of this mortar sustained a weight of 519lbs., only 50lbs. more than was borne by the prism made of Theil lime.

A prism of mortar composed of one part of lime from Vitry le Français, and two parts of sand, sustained, after four months immersion, a weight of 145lbs.

The lime from Sury (Loire,) which is generally regarded as very hydraulic, mixed with double its volume of sand, gave a prism of mortar which, after four months' immersion, broke under the weight of 64lbs. The resistance of this mortar was therefore hardly equal to the seventh of that of the mortar made of Theil lime. The small resistance of the mortar made of Sury lime, the hydraulic quality of which has been long known, resulted doubtless from some defect in the prism—perhaps an imperceptible crack.

Calcareous Stones and Earths which afford Lime-cements.

Every locality does not present the alternation of limestone and clay which facilitates the research for natural hydraulic limes; and it often happens that there is but one rock, and that, nearly homogeneous. Towards the middle of the chalk formation between Chalons and Troyes, the chalk is an almost pure calcareous carbonate, in which we seek in vain for a layer sufficiently argillaceous to afford hydraulic lime. The calcareous rocks, so abundant in the tertiary and secondary, are almost entirely wanting, or are only rarely found, in the lower formations. In these formations, there is no room for choice; it is necessary to use such limestone as can be found, and these rarely contain the proportion of clay that will yield hydraulic lime; but it is not rare to find, in these localities, substances which will give, by a moderate calcination, the *lime cements.* The greater part of the marls are of this sort, the clay and the lime composing them existing in variable proportions comprised within the limits affording *lime cements*: these substances are very common in France, and it will be as economical as advantageous, to give to fat lime the required degree of hydraulic property by mixing therewith marls calcined and pulverized.

When we are at liberty to choose, the marls that contain little or no sand should be preferred, so that the hydraulic paste which they assist in forming may bear the greater proportion of sand, and give a greater volume of mortar.

The calcination of marls requires a degree of heat less than that necessary

to the calcination of limestone: when the fire is too great they vitrify, and form a double silicate with base of lime and alumine; when the fire is less ardent, they give a compact substance of which the fracture is slightly vitreous; this matter is difficult to pulverize, and gives a nearly inert cement; when the degree of heat is just sufficient, the fracture is dull, and the substance is generally easy to pulverise. Such wheels as are used in extensive works, for making mortar, will suffice to this end. When the degree of heat is insufficient, the cement is mixed with earthy portions which impair its energy.

It is difficult to give a general rule for the calcination of marls, because some require a degree of heat quite elevated. To ascertain, by an easy experiment, the degree of heat that each kind requires, the portion may be moulded into the form of a cylinder $4\frac{8}{10}$ inch in length by $1\frac{2}{10}$ inch in diameter, and exposed, one end in a violent fire, and the other on, or near, the outside of the fire; when the most highly heated end has begun to vitrify, the cylinder may be withdrawn from the fire and divided into four parts according to the apparent effects of the different degrees of calcination: by pulverizing each, it is easy to determine the degree of calcination which gives the most energetic cements: to prevent the cylinder breaking in the fire it is necessary to mould it around a wire.

It is requisite that the burned marl be pulverized, before the mixture with the lime; otherwise, the marl will absorb water, which will impair the energy of the powder, and prevent its intimate combination with the lime.

I had occasion to try several marls from the Departments of Loire, Ardennes, Maine and Rhone; they all gave good results. Parker's cement (English,) the Boulogne pebbles, and the Saint-Leger cement, are derived from marly stones which contain about as much clay as lime.

The Senonches lime comes from a marl containing more lime than clay: all these substances are, consequently, so many lime cements.

I made numerous experiments with three kinds of marl the analyses of which are inserted in table LXVII, columns Nos. 6, 7 and 8.

The first comes from Saint-Just, department of Loire, the second from Aubigny in the same department, and the third from the Rhone at Lyons and at Givors.

The marl of Saint-Just contains only 36 parts of lime united with 41 parts of clay; this marl, calcined and pulverized, gives a very energetic lime cement.

The 5th and 6th experiments of table LXIII, prove that 8 and 7 parts of powdered marl united with 2 and 3 parts of lime, gave a hydraulic paste which, hardly two months old, sustained the weight of 361 and 312lbs.

The experiments 27, 28, and 29 of table LXIV, show that mortars four months old, composed of a hydraulic paste, half of which was made up of powdered marl from Saint-Just, mixed with twice its volume of sand, broke under the weight of 92lbs. The want of resistance in these mortars arises from the excess of sand. The Aubigny marl contains only twenty-five parts of lime to fifty-five parts of clay: this marl, calcined and pulverized, affords a lime-cement of moderate energy.

Experiments Nos. 11, 12, 13 and 14 of table LXIII show:

1st. That a prism of the powder, after four months immersion, broke under the weight of 154lbs.

2nd. That a prism of 9 parts of this powder, mixed with one part of fat lime broke under the weight of 141lbs.

3rd. That prisms of 8 and 7 parts of the powder, mixed with 2 and 3 parts of fat lime supported only 66 and 44lbs respectively.

The resistances of the prisms of mortar composed of powdered Aubigny marl, fat lime and sand, present much fewer irregularities than the prisms of paste.

Experiment No. 31 of table LXIV, shows that a prism of mortar made of one part of the powder and two parts of sand, immersed for four months, broke under a weight of 35lbs.; while experiment No. 34 proves that a prism of mortar composed of 4 parts of fat lime united to 6 parts of the powdered marl and 20 parts of sand, did not break till the load amounted to 174lbs.

The slight resistance of prism No. 31 results, evidently, from the excess of sand mixed with a powder whereof more than half already performed the office of sand, so that the prism contained hardly $\frac{1}{5}$ of powder susceptible of conversion into lime.

The Givors marl contains only 24 parts of lime united with 55 parts of clay, but, after burning, it is easier to pulverise than the marl of Aubigny, and gives a more energetic powder.

Experiment No. 3 of table LXIII, shows that a prism of this powder made into paste, after two months immersion, supported 222lbs.

Experiment No. 4 shows that another prism, of which the paste was composed of 4 parts of fat lime united to 6 parts of the powder, broke with the weight of 165lbs.

Experiment No. 26 of table LXIV, shows that a prism of mortar, one month old, composed of 1 part of powdered marl and three parts of sand, broke with the load of 37lbs.

Experiment No. 13 shows that a mortar composed of 1 part of the marl in powder and 2 parts of sand, broke under the weight of 51lbs., while experiment No. 23 shows that a mortar composed of two parts of powdered marl and 1 part of sand, sustained the load of 224lbs. Sand mixed with pastes made of powdered marl reduces their resistance, therefore, very much: this effect is less sensible with hydraulic pastes composed of fat lime and powdered marl, as seems to be proved by experiments No. 14, 15, 16, 17, 18, 19, 20, 21 and 22.

According to experiment No 22 of table LXIV, a mortar composed of 1 part of fat lime, 1 part of powdered marl and 2.40 of sand, broke with the load of 134lbs.

According to experiment No. 20, a mortar composed of 1 part of fat lime, 1 part of powdered marl, and 2.50 of sand, broke with the load of 136lbs.

And according to experiment No. 18, a mortar composed of 1 part of lime, 1 part of powdered marl, and 1.60 of sand, broke with the load of 139lbs.

These mortars being hardly a month old, the trials do not show sufficiently the influence of lime: I wished that more time should elapse, but being called away by particular circumstances, I preferred shortening the period to leaving out these trials.

Earths which will afford Hydraulic Cements.

The substances that I have designated *hydraulic cements*, and which are composed of 7, 8, and 9 parts of clay, respectively mixed with 3, 2 and 1 parts of lime, are true artificial puzzolanas; for analysis has shown that na-

tural pozzolanas contain about $\frac{1}{11}$ of lime combined with silex and alumine. The greater part of argillaceous earths, and marls, effervescing with acids, and containing less than 40 per cent. of lime, may, when they do not contain too much sand, give by calcination and pulverization, natural hydraulic cements, susceptible of hardening under water. Each of these cements without any addition of lime, may, on being mixed with a quantity of sand equal to its volume, constitute a hydraulic mortar, but this mortar is much too meagre to be employed in masonry.

The yellow and white marls, which are very common in Champagne, give good hydraulic cements: I have found some of this kind on the little hills west of the town of Rethel; I have also encountered it at other points in the valleys of the Aisne and of the Maine. These earths mixed with a certain quantity of sand, serve to make bricks which are very light after being burned. When these bricks have not been exposed to a fire of such intensity as to cause a beginning of vitrification, they acquire great hardness under water: several millions of these bricks were made under my inspection, and used in the works of the canal of Ardennes. When the substance of the brick is vitrified, mortar adheres to it but feebly. To form good masses of masonry, bricks of which the substance is not vitrified and which have preserved the red colour, should be preferred; these are, in fact, unpulverized cement, having much affinity for lime, and to which mortars adhere strongly.

Clay, or argillaceous earth—Common Cement.—All clays, or argillaceous earth, not calcareous, burned more or less and pulverized, afford *common cement.* The cement commonly used is made from fragments of bricks or tiles. When the argillaceous earths of which cements are to be made, are exposed to a high degree of heat, they begin to melt and become fritty; in this state the pulverization becomes difficult, and the cement they afford is inert, and but little different from sand.

Of all the common cements that I had occasion to try, the most energetic was derived from the clay of Bédouan, in the department of Ardèche; the results of the analysis of this clay, are to be found in the third column of table LVII.

Experiment No. 15 of table No. LXIII shows that a prism of hydraulic paste, composed of 2 parts of lime and 5 parts of cement, after four months immersion, broke under a weight of 759 lbs.: an equal prism of Theil hydraulic lime, the best that I know, supported only 229 lbs.

Experiment No. 50 of table No. LXIV shows that a mortar composed of 1 part of the above hydraulic paste and 1 part of sand, after four months immersion, broke under a weight of 733 lbs.

Mortar composed of 1 part of Theil lime and 2 parts of sand, broke with a load of 469 lbs.; an equal prism of mortar obtained from a Roman aqueduct, about sixteen centuries old, broke under a load of 519 lbs.

These experiments prove that the hydraulic pastes and mortars which acquire in a short time the greatest strength, are those which are composed of a cement analogous to that furnished by the Bédouan clay.

I concluded the experiments on common cements by seeking to ascertain whether iron would augment the energy of the clay: to this end I mixed with clay different proportions of a ferruginous mineral (carbonate of iron mixed with carbonate of lime) and I pulverized the whole after burning.

The experiments from No. 17 to No. 25 in table LXIII, show the resistances of the hydraulic pastes made of clay-cements and the mineral: experiments from No. 41 to 49 of table No. LXIV, show the resistances of

the mortars composed of this paste. It results from these two series of experiments that the mineral does not augment the energy of the cement, and that it even diminishes it, when the clay contains more than two-thirds of the substance.

ARTICLE XXII.—*Summary and Conclusion.*

From all that precedes, it results, that in going over the combinations that may be obtained by mixing clay not calcareous, and fat lime, in various proportions, we get, first, *hydraulic lime*, which contains as high as $\frac{1}{5}$ of clay; the combinations above this, containing from $\frac{1}{5}$ to $\frac{3}{8}$ of clay, possess at the same time the property of lime and of cement, and for this reason I have designated them as *lime cements;* lastly, the higher combinations, containing from $\frac{3}{8}$ to $\frac{9}{10}$ of clay, may have applied especially to them, the name of *hydraulic cement*, because of their being susceptible of forming hydraulic mortars, alone, or with the addition of a small quantity of lime.

Hydraulic lime.—The properties of hydraulic lime being well known, I have no further occupied myself therewith than was necessary to complete the general examination of the combinations of lime and clay, and to present some observations on the superposition of those calcareous rocks that contain the quantity of clay necessary to produce natural hydraulic limes.

Lime cements.—The combinations that I have called *lime-cements* having been but little examined hitherto, I have given to the study of their different properties, particular care. These combinations burned, pulverized, made into paste and immersed, harden under water very promptly; mixed with an equal volume of sand, or even with a double volume, they give a very good hydraulic mortar; mixed with fat lime at the moment of slaking, they give to this lime a hydraulic power depending on the proportions of the mixture: 2 parts of *lime cement* make 3 parts of fat lime very hydraulic; a still smaller quantity of *lime-cement* might suffice, and but rarely would more be necessary; unless it were thought proper to give to the paste a hydraulic energy superior to that of the best limes.

Very argillaceous limestones, and the greater part of the marls, which are very common in France, give, by moderate burning, natural *lime-cements*; we may therefore give to fat lime, a suitable degree of hydraulic energy, by mixing with it certain quantities of burnt and pulverized marl; the proportions should vary with the energy of the particular kind of pulverized marl at command; but it will be rarely necessary to exceed the proportion of two parts of powdered marl to three parts of fat lime.

At Lyons, and on the canal of Givors, use is made, for works under water, of the eminently hydraulic lime of Theil; but the marls found near these localities, of which I have ascertained the properties, might, on being mixed with fat lime, be substituted advantageously for Theil lime, of which the cubic metre (35.34 cubic feet) costs $8 55. Half of fat lime at $3.04, and half of powdered marl at $1.90, will give a very hydraulic paste, of which the cubic metre will cost only $2.47: the economy that will result from the use of this paste will be very sensible in the prolongation of the canal of Givors, of which the works will consume 10,000 cubic metres of the Theil lime.

In those localities where fuel is dear, and where there is not a supply of either natural hydraulic lime, or of marl susceptible of affording a *lime-cement*, it will be better to use an artificial *lime-cement*, than an artificial hydraulic lime; in fact, in a quantity of hydraulic lime obtained by mix-

ture of fat lime and *lime-cement*, the last substance forming, at most, the half of the total volume, its use will reduce, in this ratio, the cost of burning, and of fabrication; on the other hand, fat lime and *lime-cements* will be more easy to preserve than hydraulic lime; and there will be, moreover, the advantage of varying the degree of hydraulic energy, and of retarding the conversion of fat lime into hydraulic lime until the moment it is to be applied.

Hydraulic cement.—The combinations to which I propose affixing the name of *hydraulic cement*, possess the property of giving, either alone, or mixed with an equal volume of sand, an hydraulic mortar more or less meagre. These cements united with fat lime, form pastes which harden under water, within the space of fifteen days. 1 part of cement suffices to render 2 parts of fat lime hydraulic.

The greater part of argillaceous and calcareous earths—very common every where—are proper to afford hydraulic cements, by burning and pulverization: the burning should be moderated, to prevent the matter from becoming fritty and inert.

When these argillaceous or calcareous earths contain a certain quantity of sand, they serve to make bricks, which are true hydraulic cements not pulverized; these bricks are very light after burning, and appear to want strength unless they have sustained a commencement of vitrification; but they adhere strongly to mortars, and when they are used under water, they soon acquire all requisite hardness; if, during the burning, these bricks are highly heated, they become fritty, often without changing form; but, in this state, they adhere but slightly to mortars, the cement of which they are composed having then become completely inert.

At the canal of Ardennes I had occasion to apply a portion of the preceding observations; because for the works of that part of the canal which lies in the valley of the Aisne there were no other materials than the argillo-calcareous earth covering the bottom of the valley, and the tender, chalky rocks that formed the slopes, together with earth and stones as tender as the chalk.

Different trials made on a small scale showed me, however, that, with care, bricks might be made of the earth from the valley: other trials brought to light, in the gray or chlorite chalk, strata affording hydraulic lime, so that in the course of the years 1826, 1827 and 1828, locks and other works were built with bricks made of the earth of the valley, hydraulic lime from the chalk, and masses of chalk, laid behind the facings of bricks.

Even in a chalky region, where no other materials of construction can be found than chalk, marls, and argillo-calcareous earths, and where, for this reason, the greater number of buildings are of wood, we may, therefore, erect works as solid as elsewhere.

Common cements.—As to *common cements*, I will limit myself to saying that they are the more energetic as they are derived from clays the more refractory: I will say further, that it appears evident to me, the resulting hydraulic pastes and mortars afford more resistance than the analogous mortars composed of hydraulic lime.

Lastly, I will deduce from the second portion of the facts reported by me, that in every locality where limestones, marls, or argillo-calcareous earths are to be found, hydraulic pastes and hydraulic mortars may be obtained at small expense; and that the resistances of one and the other may be caused to vary from 44 lbs. to 759 lbs. for prisms 2 inches long by $1\frac{8}{10}$ inch square.

Such are the observations I have had occasion to make: I know they are very incomplete, and that enough has not been done to show the influence of time on the resistance of pastes and hydraulic mortars: but if the results at which I have arrived are deemed worthy of the attention of constructors, I shall have attained the object, I proposed to myself.

Table No. LVII.

Analyses of several natural combinations of lime and clay, susceptible of giving after burning, hydraulic pastes, either alone or mixed with fat lime.

	Brick earth from Rive-de-gier.	White clay from Rive-de-Gier.	Clay from Bédoreau.	Limestone from Theil.	MARLS From Echaur.	MARLS From St. Just.	MARLS From Aubigny.	MARLS From Givors.	Remarks.
	1	2	3	4	5	6	7	8	These analyses were made at the School of Mines of St. Etienne, by M. Socart, Chemist. I am indebted for them to Messrs Delsériès and Clapeyron, Engineers of Mines.
Water	8.00	5.80	12.00	3.00	6.20	6.80	12.20	13.20	
Carbonate of lime		9.20		76.80	53.20	35.40	24.80	23.80	
Carbonate of magnesia		1.60		trace	2.00	1.20	0.00	0.80	
				79.80	61.40	43.40	37.00	37.80	
CLAY: Silex	57.80	60.00	52.00	14.40	22.00	26.00	38.40	39.60	
CLAY: Alumine	19.60	14.80	28.00	2.80	7.20	15.00	11.60	7.00	
CLAY: Lime	2.00		3.00	1.20	1.40	2.00	5.40	8.40	
CLAY: Magnesia	0.00		1.00	0.40	0.00	1.20	0.00	1.60	
CLAY: Oxide of iron	12.40	8.40	2.00	0.80	7.60	11.60	7.20	4.80	
Totals	99.80	99.80	98.00	99.40	99.20	99.20	99.60	89.60	

Table LVIII.

Analyses of natural combinations of lime and clay—extracted from the work of Gen. Treussart.

	Clays.			Hydraulic Lime.			Lime Cements.			Hydraulic Cements.		
	Pipe clay from Cologne.	From Frankfort.	From Sulfenheim.	From Saint Germain.	From Metz.	From Senonches.	Parker's cement, (English.)	Boulogne pebbles.	Cement from Pouilly.	Puzzolana.	Trass.	Calcined Basalt from Haute Loire.
	9	10	11	12	13	14	15	16	17	18	19	20
Water	6.60	16.00	7.80							9.20	9.60	2.00
Lime				83.00	68.30	70.00	55.40	54.00	42.86	8.80	2.60	9.50
Clay: Silex	67.00	50.00	72.40							44.50	57.00	44.50
Clay: Alumine	24.00	32.70	11.80							15.00	12.00	16.75
				clay	clay	clay	clay	clay	clay			
Clay: Magnesia	1.20	1.50	2.00	17.00	31.70	30	44.60	46.00	57.14	4.70	1.00	
Clay: Peroxide of Iron	1.20		4.80							12.00	5.00	20.00
Potassa										1.40	7.00	
Soda										4.00	1.00	2.60
Oxide of Manganese												2.37
Totals	100.00	100.20	98.80	100.00	100.00	100.00	100.00	100.00	100.00	99.60	99.20	97.72

Table LIX.

Degree of penetration of a stem 0.047 inch in diameter, and $\frac{2}{3}$ of a pound av. in weight, falling from a height of 0.787 inch upon prisms of artificial hydraulic paste, immersed for 15 days.

General Classification.	Substances (a) or combinations of the first order.	Combinations of the second order, or artificial hydraulic pastes, formed of a mixture of each substance (a) or combination of the first order, in various proportions with fat lime—the proportion being as follows, viz:									
		Substance (a) 10 / Fat lime 0	9 / 1	8 / 2	7 / 3	6 / 4	5 / 5	4 / 6	3 / 7	2 / 8	1 / 9
		inch	inch	inch	inch	inch	inch	inch	inch	inch	inch
Common cement	10 of burnt clay, 0 of lime	1.772	0.000	0.000	0.000	0.000	0.039	0.118	0.118	0.118	0.275
Hydraulic cement	9 of burnt clay, 1 of lime	0.039	0.000	0.000	0.000	0.078	0.078	0.118	0.078	0.590	0.512
	8 of burnt clay, 2 of lime	0.039	0.039	0.000	0.000	0.078	0.039	0.078	0.472	0.156	0.195
	7 of burnt clay, 3 of lime	0.039	0.039	0.039	0.078	0.156	0.039	0.078	0.156	0.236	0.275
Lime cement	6 of burnt clay, 4 of lime	0.078	0.118	0.078	0.039	0.039	0.078	0.236	0.118	0.551	0.236
	5 of burnt clay, 5 of lime	0.000	0.000	0.000	0.078	0.078	0.039	0.118	0.118	0.118	0.118
	4 of burnt clay, 6 of lime	0.000	0.039	0.039	0.118	0.118	0.039	0.195	0.195	0.195	0.275
	3 of burnt clay, 7 of lime	0.000	0.078	0.078	0.118	0.078	0.118	0.236	0.118	0.118	0.118
Hydraulic lime	2 of burnt clay, 8 of lime	0.118	0.078	0.156	0.156	0.156	0.236	0.473	0.195	0.275	0.195
	1 of burnt clay, 9 of lime	0.394	0.472	0.195	0.195	0.195	0.787	0.195	0.669	0.787	1.575
Fat lime	0 of burnt clay, 10 of lime	1.772									

Table LX.

Degree of penetration of a stem 0.047 inch in diameter, and $\frac{2}{3}$ of a pound avoirdupois in weight, falling from a height of 1.575 inch upon prisms of artificial hydraulic paste, immersed for two months.

General Classification.	Substances (a) or combinations of the first order.	Combinations of the second order, or artificial hydraulic pastes, formed of a mixture of each substance (a) or combination of the first order, in various proportions with fat lime—the proportions being as follows, viz:									
		Substance (a) 10 Fat lime 0	9 1	8 2	7 3	6 4	5 5	4 6	3 7	2 8	1 9
		inch	inch	inch	inch	inch	inch	inch	inch	inch	inch
Common cement	10 of burnt clay 0 of lime	1.772	0.000	0.000	0.039	0.039	0.078	0.118	0.118	0.156	0.275
Hydraulic cement	9 of clay 1 of lime	0.078	0.159	0.000	0.000	0.039	0.039	0.039	0.039	0.078	0.118
	8 of clay 2 of lime	0.078	0.019	0.000	0.000	0.000	0.019	0.019	0.039	0.078	0.118
	7 of clay 3 of lime	0.039	0.039	0.000	0.019	0.019	0.019	0.039	0.078	0.118	0.275
Lime cement	6 of clay 4 of lime	0.039	0.039	0.039	0.019	0.039	0.059	0.078	0.078	0.118	0.118
	5 of clay 5 of lime	0.000	0.000	0.000	0.019	0.019	0.039	0.039	0.039	0.078	0.078
	4 of clay 6 of lime	0.000	0.039	0.019	0.078	0.078	0.118	0.078	0.078	0.078	0.118
	3 of clay 7 of lime	0.000	0.019	0.195	0.039	0.039	0.059	0.078	0.098	0.118	0.118
Hydraulic lime	2 of clay 8 of lime	0.039	0.078	0.118	0.118	0.118	0.118	0.156	0.156	0.118	0.118
	1 of clay 9 of lime	0.118	0.156	0.118	0.118	0.236	0.393	0.275	0.315	0.315	0.315
Fat lime	0 of clay 10 of lime	1.772									

Table LXI.

Weights that broke the prisms of artificial hydraulic paste—immersed for four months.

General classification.	Substance (a) or combinations of the first order.	Combination of the second order, or artificial hydraulic pastes formed of a mixture of each substance (a) or combination of the first order in various proportions with fat lime—the proportions being as follows, viz:									
		Substances (a) 10 Fat lime 0	9 1	8 2	7 3	6 4	5 5	4 6	3 7	2 8	1 9
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Common cement	10 of burnt clay 0 of lime	0	209	334	356	290	229	143	139	59	33
Hydraulic cements	9 of clay 1 of lime	59	262	297	255	297	218	180	194	121	19
	8 of clay 2 of lime	33	321	249	363	319	275	235	125	154	44
	7 of clay 3 of lime	194	356	350	257	205	300	119	143	73	55
Lime cements	6 of clay 4 of lime	152	249	229	255	255	185	141	130	68	53
	5 of clay 5 of lime	438	235	387	185	180	341	194	132	99	48
	4 of clay 6 of lime	396	183	275	172	200	119	121	108	99	64
	3 of clay 7 of lime	194	178	304	156	147	136	77	161	123	79
Hydraulic cements	2 of clay 8 of lime	139	207	114	134	152	0	81	106	84	53
	1 of clay 9 of lime	70	75	86	97	51	44	40	33	33	29

Table LXII.

Weights which broke prisms of *mortar* or combinations of the third order—immersed during four months, and composed of the several artificial hydraulic pastes mentioned in the preceding table—mixed with double the volume of sand.

General classification.	Substances (a) or combinations of the first order.	Combinations of the third order, or mortars made by mixing each of the hydraulic pastes of the second order mentioned below—with double its volume of sand NB. The several hydraulic pastes are composed as in the preceding tables, viz.									
		Substance (a) 10 Fat lime 0	9 1	8 2	7 3	6 4	5 5	4 6	3 7	2 8	1 9
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Common cement	10 of burnt clay 0 of lime	0	161	99	183	169	185	132	123	79	75
Hydraulic cement	9 of clay 1 of lime	48	147	163	143	183	185	205	114	117	55
	8 of clay 2 of lime	73	128	167	174	161	326	198	134	183	141
	7 of clay 3 of lime	95	187	147	128	200	123	167	106	119	44
Lime cement	6 of clay 4 of lime	75	222	209	198	169	224	158	114	141	55
	5 of clay 5 of lime	185	75	200	209	218	178	154	139	119	70
	4 of clay 6 of lime	51	350	290	407	277	165	156	187	141	176
	3 of clay 7 of lime	152	156	218	275	202	249	101	202	172	211
Hydraulic lime	2 of clay 8 of lime	150	187	145	172	145	191	200	150	134	121
	1 of clay 9 of lime	143	128	152	167	134	112	106	55	70	73

Table LXIII.

Resistance to rupture of prisms of paste of various natural hydraulic substances.

Nos. in the series.	Nature of the hydraulic paste.	Age of the paste or duration of immersion.	Fat lime and Hydraulic lime.	Hydraulic cement and lime cement.	Weight which caused rupture.
					lbs.
1	Theil lime . . .	4 mo.	1	0	228
2	Pouilly cement . . .	do.	0	1	431
3	Givors' marl alone . .	2 mo.	0	1	222
4	do. and fat lime . .	do.	4	6	165
5	St. Just marl, and fat lime .	do.	2	8	361
6	do. . . .	do.	3	7	312
7	do. . . .	do.	6	4	167
8	do. . . .	do.	7	3	132
9	do. . . .	do.	8	2	88
10	do. . . .	do.	9	1	77
11	Aubigny marl, alone . .	4 mo.	0	1	154
12	do. and fat lime . .	do.	1	9	141
13	do. . . .	do.	2	8	66
14	do. . . .	do.	3	7	44
15	Cement from Bédouan clay and fat lime .	do.	2	5	759
16	Prism of burnt earth . .	do.			194
	Clay cements and a ferruginous cement burnt together and pulverized.				
17	9 of clay and 1 of the minerals .	3 mo.	2	5	209
18	8 do. 2 do. .	do.	2	5	218
19	7 do. 3 do. .	do.	2	5	308
20	6 do. 4 do. .	do.	2	5	114
21	5 do. 5 do. .	do.	2	5	216
22	4 do. 6 do. . .	do.	2	5	273
23	3 do. 7 do. . .	do.	2	5	224
24	2 do. 8 do. .	do.	2	5	136
25	1 do. 1 do. , .	do.	2	5	112

Table LXIV.

Resistance to rupture of prisms of different mortars—made with natural hydraulic pastes.

Nos. in the series.	Nature of the hydraulic paste used in making this mortar.	Age of the mortars or duration of immersion.	Fat limes and Hydraulic lime.	Hydraulic cement and lime cement.	Silecious Sand from Givors.	Weights that caused the rupture.
	Hydraulic Limes.					lbs.
1	Lime from Chanay near Macon .	4 mo.	1	0	2.00	39.6
2	do. Sury (Loire) .	do.	1	0	2.00	66.0
3	do. Theil (Ardèche) .	do.	1	0	2.00	469.0
4	do. . .	1 mo.	1	0	1.00	75.0
5	do. . .	do.	1	0	1.50	81.0
6	do. . .	do.	1	0	2.00	66.0

Table LXIV.—Continued.

Nos in the series.	Nature of the hydraulic paste used in making the mortar.	Age of mortar or duration of immersion.	Fat lime and Hydraulic lime.	Hydraulic cement and lime cement.	Silicious sand from Givors.	Weights that caused the rupture.
	Hydraulic limes.					lbs.
7	Lime from Theil (Ardèche)	1 mo.	1	0	2.50	68.2
8	do.	do.	1	0	3.00	66.0
9	do.	do.	1	0	3.50	63.8
10	do.	do.	1	0	4.00	69.4
11	Saint-Leger cement, near Châlons-sur-Saône	4 mo.	0	1	2.00	160.6
12	Pouilly cement	do.	0	1	2.00	297.0
13	Marl from Givors, alone	1 mo.	0	1	2.00	50.6
14	do. and fat lime	do.	1	1	3.00	88.0
15	do.	do.	1	1	1.00	105.6
16	do.	do.	1	1	1.20	101.2
17	do.	do.	1	1	1.40	121.0
18	do.	do.	1	1	1.60	138.6
19	do.	do.	1	1	1.80	107.8
20	do.	do.	1	1	2.00	136.4
21	do.	do.	1	1	2.20	118.8
22	do.	do.	1	1	2.40	134.2
23	Marl from Givors, alone	do.	0	2	1.00	224.4
24	do.	do.	0	3	2.00	94.6
25	do.	do.	0	6	5.00	44.0
26	do.	do.	0	1	3.00	37.4
27	Marl from St. Just, and fat lime	4 mo.	4	6	20.00	143.0
28	do.	do.	5	5	20.00	92.4
29	do.	do.	6	4	20.00	77.0
30	Marl from Aubigny, alone,	do.	0	1	2.00	35.2
31	do. and fat lime	do.	1	9	20.00	70.4
32	do.	do.	2	8	20.00	74.8
33	do.	do.	3	7	20.00	125.4
34	do.	do.	4	6	20.00	173.8
35	do.	do.	5	5	20.00	94.6
36	do.	do.	6	4	20.00	70.4
37	do.	do.	7	3	20.00	101.2
38	do.	do.	8	2	20.00	37.4
39	do.	do.	9	1	20.00	52.8
40	do.	do.	5	5	15.00	121.0
	Lime cements and clay cements mixed with the ferruginous mineral.					
41	9 of clay and 1 of the mineral	do.	4	10	14.00	583.0
42	8 do. 2 do.	do.	4	10	14.00	294.8
43	7 do. 3 do.	do.	4	10	14.00	242.0
44	6 do. 4 do.	do.	4	10	14.00	134.0
45	5 do. 5 do.	do.	4	10	14.00	224.4
46	4 do. 6 do.	do.	4	10	14.00	319.0
47	3 do. 7 do.	do.	4	10	14.00	145.2
48	2 do. 8 do.	do.	4	10	14.00	127.6
49	1 do. 9 do.	do.	4	10	14.00	105.6
50	Fat lime and Bedouan clay	do.	4	10	14.00	732.6
51	Lime and clay from Rive-de-Geir	do.	4	10	14.00	642.4
52	Mortar from a Roman aqueduct	18 cen.				519.2
53	Prism of burnt earth					293.8

(TO BE CONTINUED.)

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

New mode of obtaining Metallic Osmium. By Professor Ellet.

The residue of the ore of Platinum after the action of the nitro-muriatic acid, and which consists principally of osmium and iridium is to be intimately mixed with an equal weight of chlorate of potassa, and the mass introduced into a green glass retort. On the application of a heat approaching to redness, the mass becomes suddenly ignited and a torrent of mixed oxide of osmium and free oxygen passes over. If the neck of the retort be inserted in a deep vessel of strong liquid ammonia, an *osmiate of ammonia* is formed and remains in solution, while the excess of oxygen escapes in bubbles. The solution of osmiate of ammonia by careful evaporation yields an imperfectly crystallized mass of prisms of a brown colour. These are to be introduced into a glass tube closed at one extremity and exposed in the flame of a spirit lamp, to a temperature of 400° to 500° Fahr. The mouth of the tube should be closed by the thumb. Decomposition ensues, the hydrogen of the ammonia decomposing the oxide, with the evolution of aqueous vapour and nitrogen gas, which is instantaneous, and is remarked by a sensible pressure on the thumb. The residual solid contents of the tube will be pure metallic osmium—in the form of a black powder.

If it be desired to exhibit the metallic lustre of the osmium, we may introduce a portion of the ammoniacal osmiate into a very small retort, pour upon it an excess of sulphuric acid—and apply a moderate heat. Osmic acid will be volatized. If now a stream of hydrogen gas be introduced into the neck of the retort, so as to blend with the osmic acid vapors, and the neck be heated to redness by means of a Cooper's lamp, reduction takes place, and a crust of metallic osmium, having the lustre and brilliancy of silex, lines the tubes

South Carolina College, Columbia, S. C. May 7th, 1838.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

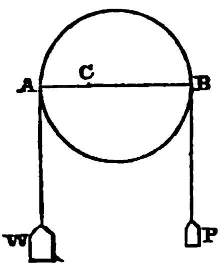
The following remarks, on a subject recently discussed in the Journal, are offered for insertion, by Trochilia.

The method by which some writers explain the properties of the pulley, regarding it as a lever of the first or second order, and which has been insisted on, in a late number of the "Journal," will appear upon a slight examination, to be unfounded, and to lead to false results.

The method in question is unfounded, because, it supposes a power applied, where, aside from the consideration of friction, none exists. A rope moving in the groove of a pulley exerts no tendency to turn it on its axis, except what arises from friction,—the very defect of the instrument which the pulley, properly so called, is intended to obviate. The mistaken notion that the pulley, like the wheel and axle, is only a modification of the lever, has evidently arisen from the fact that the pulley actually turns, and that one extremity of its horizontal diameter does, in the movable pulley, for an infinitely small portion of time, move through twice the space passed over by the weight attached to the centre, while the other extremity of the diameter remains for an instant stationary; indeed, inasmuch as the pulley turns on its axis, *it is a lever*; but the power applied to it, is not that which raises the weight, but only that portion of it which is lost in consequence

of friction; and since the theoretical consideration of a mechanical power should have no reference to friction, it is plain that the idea of a lever should be excluded from our reasoning upon the pulley.

Let us suppose a pulley to be so constructed that its centre of gravity shall be at C; A, C, being supposed half of B, C, and let C, be the centre of motion of the pulley,—then, if the lever principle is applicable, a weight W, of two pounds, and a power P, of one pound should be in equilibrium: but the fact evidently is that W, would descend in consequence of the excess of its gravity over that of P. Disregarding the weight of the string, the centre of gravity of the system composed of the pulley, the power and the weight would evidently be in the vertical line drawn through C, and this being the case, there would be no tendency in the pulley to change its position during the descent of W, except so far as it would be affected by friction;—indeed any motion of the pulley must necessarily throw the common centre of gravity of the weight and power out of the perpendicular line in which it will descend if the pulley remain stationary.



I have confined my remarks to the fixed pulley for the sake of simplicity, but the same objections to the assumption of the lever principle, will apply in whatever form the pulley may be used.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN AUGUST, 1837.

With Remarks and Exemplifications by the Editor.

235. For a machine for *Spreading Adhesive and other Plasters;* B. Morison, Milton, Northumberland county, Pennsylvania, August 8.

A metallic trough is made, which has two sides sloping towards each other at bottom, but they do not meet, the bottom being open for the length of the trough. This trough fits on to a metal roller, which may be about five inches in diameter; below this there is a wooden roller upon which the cloth to be spread is wound. The outer end of this cloth is to be passed between the metal roller and the trough, which are secured at such distance apart as to allow for it, and for the thickness to be given to the plaster; this latter is to be brought to a semi-fluid state by heat, and poured into the trough. It is then drawn out by an assistant, whilst another turns a winch upon the axis of the metal roller, to cause the cloth to pass readily through; this unwinds the cloth from the wooden roller, which is kept from too free a motion by corks bearing against its gudgeons. The claims made include the general structure of the machine as described.

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236. For an improvement in the *Rotary Steam Engine;* Ashur Miller, Lockport, Niagara county, New York, August 8.

The nature of the invention, we are told, "consists in a revolving piston, and in applying the steam thereto by means of a side pipe, eccentric, or cam, and shifting or slide valve, as ordinarily applied to a reciprocating en-

gine, thereby giving the piston a perfect rotary motion; which may be constructed on the high or low pressure principle." The patentee says that his engine "will be recommended by its simplicity. It will require less machinery than engines now in use, and thus avoid much friction. And the inventor believes it will give more power with the same quantity of steam than any engine now in use. Another advantage gained over the common reciprocating engine is the continued, constant, and equal, pressure of the steam upon the piston in one direction, thus avoiding those dead points at which, in the common reciprocating engine, foreign aid is required to start it." The claim is to "the combination of the shifting or slide valve with the rotary piston, as in the above specification."

This engine is, in general, the counterpart of some which have long been in the field, or rather on the shelf. The revolving piston has nothing new in it, but in the side pipes and slide valve there may, and it is believed there is, novelty, but unaccompanied by any thing tending to remove the faults which have consigned a host of rotary engines to oblivion. The slide valve, on the top of the engine, is to admit steam alternately into two hinged valves, placed opposite to each other; but what better effect this is to produce on the revolving piston we cannot perceive. The slide valve and its appurtenances do not, certainly, simplify the arrangement, and ought therefore to produce some substantial benefit. Should a condenser be added to work it on the low pressure principle, there would be another source of complexity, but scarcely of utility. Without hoping that there will, we are not prepared so say that there will not, be discovered a rotary engine of moderate power, and equally economical and durable with the reciprocating; but we have no hope that the one before us will take this station.

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237. For an improved mode of *Applying Warm Air to Fires;* John Silsbe, Tyrone, Steuben county, New York, August 8.

Whether this contrivance is for forge backs, for common fires, or for fires of all descriptions, we are not told. It appears, however, that there is to be a metal box, cast-iron we suppose, into which the air is to pass through a hole in the back plate, whether by blowing, or spontaneously, we know not. In the front plate there is to be a longitudinal opening, say five inches long, and half an inch wide, enlarging inwards. Three plugs, or stoppers, ranged side by side, are to close these openings if required. Three rods cross the interior of the box, and pass through the back plate, to govern the three stoppers. The mouth piece is made separate from the box, so that it can be renewed. We have told all.

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238. For a *Substitute for Gum Senegal;* Walter Leversidge, Dorchester, Norfolk county, Massachusetts; Patent issued in August, but dated May 30. (See Specification.)

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239. For a machine for *Riving, Planing, and Jointing, Shingles;* Enoch R. Morrison, Pittsburgh, Alleghany county, Pennsylvania; issued in August, but dated June 15.

There is considerable novelty in the arrangement of the respective parts of this machine, although all the operations intended to be performed by it have been previously performed by means not differing essentially from those described; in the claim, therefore, the arrangement and combination described are the points upon which dependance is placed. There is an

apparent complexity in the machine, but probably not more than is necessary where the three operations of riving, planing, and jointing are to go on simultaneously.

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240. For an improvement in *Grates and Stoves;* Edward H. Dixon, New York, August 8.

The fire place, under the arrangement proposed, is to be enclosed by sliding doors, glazed, or furnished with plates of mica. In the drawing, these doors are represented as sliding into jambs in the form of Gothic towers. The claim is to the combination of the glass, or mica, door, (as applied to grates and stoves) sliding on rods or flanches, either vertically, entire, or divided, and received behind the towers on either side the fire, substantially as described; together with the pipes and valves, as arranged with the various parts together as described, to attain the effect of warming the apartment, with constant ventilation, preventing currents of air, and the escape of gas and ashes into the apartment."

Such an affair may be made to look very pretty, undoubtedly; but the enclosing the fire by means of sash will scarcely be found economical or convenient. More of the heat will be carried off by the draught, and less be diffused by radiation, we apprehend, than from an ordinary open fire; this opening and closing of sash, whenever the fire requires attention, will also be a trial of patience both to the idle and to the industrious, although from different considerations.

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241. For improvements in the common *Crank Power Loom;* Enoch Burt, Manchester, Hartford county, Connecticut; Patent issued in August, but dated February 10.

The patentee claims a particular mode of moving the shuttle box by a curvilinear cam co-operating with a horizontal lever and perpendicular rod. A particular apparatus for varying the figure is also claimed; and two modes of forming what is denominated a thread protection; which are contrivances for causing the power loom to stop when a thread breaks; by one of these the shuttle is prevented from boxing by the breaking of the bobbin thread, or from the bobbin being spent. We cannot give a description of these plans without engravings; nor could it be briefly done even with these aids.

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242. For improvements in *Cooking Stoves;* Samuel Utter, City of New York, August 8.

The claim in this stove is to "the construction of a heated air chamber under, and at the ends of, the oven of a cooking stove; which chamber is unconnected with the flues that pass over or around the oven; and which air, when heated by the fire in the stove, or grate, is admitted freely into the oven through openings made in the bottom plate thereof for that purpose." The construction of a chamber for heating air is not claimed "excepting in connexion with the openings in the bottom plate of the oven through which it is to pass, this being its sole use."

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243. For an improvement in the machine for *Teazling, or Napping, Cloth;* Benjamin Swazey, Mount Pleasant, Maine, August 8.

The claims made under this patent refer to a mode of fixing the teazles on wires, on the napping cylinder, and to a particular mode of fixing springs

in the cloth rolls, and of throwing the rolls in and out of gear, keeping it in contact with the teazles as it is wound forward, and removing it as it is wound backward.

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244. For *Stoves for Cooking;* James Wilson, City of New York, August 15.

The claims to the respective parts of this stove are of considerable length, and need not be given, as they relate to the particular modes of constructing, arranging and combining, plates, dampers, and flues in the way shown in the drawings.

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245. For improvements in *Machinery for Doubling and Twisting Sewing Silk, Worsted, Cotton and Linen Thread;* John Golding, Dedham, Massachusetts, August 15.

The claim made is to the arrangement of machinery which by the breaking of the thread stops the spindle, and throws the feeding-down-roller up, and prevents the thread from running to waste.

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246. For a *Safe for the Preservation of Papers,* which can be used as a writing desk; Daniel Fitzgerald, city of New York, August 15.

A case of sheet-iron lined with some bad, and incombustible, conductor of heat, is fixed beneath a table, or desk; the top of this box is open, and it is to receive a case, made of similar materials, for containing books and papers. This latter case is made to descend into the former, or to be raised from it, by a windlass and chain. When up, it forms a part of the writing desk, and when down, its top forms the cover of the case first named, and is flush with the table part of the desk. When the safe is raised, its doors, which are hinged at their bottom edges, fall, and form the table to write on. The claims are to the "forming a writing table of the door of the safe, or raising chest, or case. The combination of safe and desk, or writing table."

We cannot well conceive of a less promising affair than the foregoing, which could pass examination in the patent office; but things are not stopped there merely because they are trifling, provided they present any novelty and do not violate the known laws of mechanical, or of chemical philosophy. The iron part of the above described instrument is, at best, but a small iron chest, or safe, without the pretence of any new means of safety from fire.

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247. For an improved *Smut Mill;* Charles D. Childs, Mount Morris, Livingston county, New York, August 15.

The outer shell of this smut mill has the general form of a vertical cylinder, but consists of separate rings piled one above the other, the lower edge of an upper, entering within the upper edge of a lower ring, throughout the series, there being an open space left between each ring for the passage of air and dust. The inner sides of these rings are surrounded by five vertical flutes. Within the body thus formed, there is a revolving cylindrical rubber, consisting also of sections of metal, covered with teeth, and approaching the inside of the outer shell. There are protuberances of this revolving part which agitate the grain as it passes down from the feeding hole in the upper plate of the machine. The claim is to "the manner of forming and combining the cast-iron rings; leaving the annular openings for the escape of air, dust, and smut; and the manner of constructing and using the revolving fluted rasps, formed and operating as described."

248. For a *Press for Pressing Cheese and other Articles;* Sullivan White, Bridgewater, Windsor county, Vermont, August 15.

In Vol. XVI. p. 174, there is an engraving and description of a self-adjusting cheese press. That now before us is also upon the self-adjusting principle, in which the weight of the article to be pressed acts in producing the pressure, but there is considerable difference in the arrangement of the parts. The claim made is to "the arrangement and combination of friction rollers, levers, and sliding frame, by which the weight of the sliding frame, cheese, and if necessary, other weights, causes the action of the levers to be such that their power is increased in proportion to the descent of the sliding frame, so as to secure an adequate pressure at the commencement of the operation, and an increasing power in proportion to the ascent of the sliding frame; thus applying the power when and where most required."

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249. For a *Machine for Cutting Shingles and Siding from Steamed Timber;* Joseph S. Raymond, Lodi, Cattaragus county, New York, August 15.

A wheel is to be made of about eight feet in diameter, and this is to revolve vertically on its axis. Two knives are placed on one face of this wheel, of such length as may be required by the shingle to be cut. These knives are opposite to each other, extending from near the periphery towards the centre of the wheel. They are distant from the wheel so far as is required for the thickness of the shingle, and the distance varying at the two ends according to the slope of the shingle. They stand in reversed positions in this last respect, one of the knives cutting the thick, and the other, the thin, end of the shingle towards the periphery of the wheel. The shingles as they are cut pass through openings in the wheel, in the manner of the throat of a plane. The stuff is laid upon a bed and fed up by the action of weights. The bed is made to vibrate by projecting, inclined pieces on the face of the wheel.

The claims are to the reversed position of the knives; the manner of vibrating the bed upon which the stuff lies; and to a lever and knife for edging. The cutting by knives on the face of the wheel is disclaimed, as not being new, leaving the features of novelty not of a very prominent character.

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250. For an improvement in the construction of *Rain Water Cisterns*; George W. Blenis, Salina, New York, August 18.

The cisterns, of hydraulic lime, are to be constructed with their bottoms in the form of an inverted dome, in situations where the soil is wet, to enable them to resist the upward pressure of the external water.

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251. For a *Mode of applying a compound resinous Cement in making Cisterns, Reservoirs, Piers, &c.;* Thomas Coyle, Baltimore, August 18.

There is no novelty in the composition of this cement, which is formed of one part of rosin and two parts of dried clay finely pulverised. These are to be incorporated in a kettle, over a fire, and heated until of a dark brown colour, when it will become so tough as not to crack in the cold, and so hard that the heat of the sun will not make it soft. The specification describes the mode of applying it to the walls and floors of cellars, to reservoirs, &c., and then adds, "although I have described the manner of

using and applying this cement for various purposes, I wish it to be distinctly understood that I do not claim to be the inventor of the cement itself, or of its application to keep out moisture in cellars, vaults, &c.: nor do I claim the application thereof to such purposes in a heated state, this being necessary in all cases, and a thing well known. But what I do claim as my discovery is the applying it, (in places, or vessels, which contain water,) so highly heated as that it shall expel the moisture therefrom, so as effectually to adhere to pebbles, stones, wood, and other substances with which it comes into contact."

It is proposed to form piers, or columns, in water, by filling a box, or casing, with stones, and then pouring in the cement in a highly heated state, which it is averred, will disgorge the water, and heat the stones, so as to secure perfect adhesion, and great solidity in the mass.

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252. For an improvement in the *Strainers for Milk Pails;* Isaiah Bunnell, Darby, New Haven county, Connecticut, August 18.

The lip, or spout, of a milk pail, instead of being punched full of small holes in the usual way, is to have a piece of wire gauze soldered in its place. "This pail is used for milking, and the milk is perfectly strained by simply pouring it through the spout into the receiving vessel."

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253. For an improvement in the mode of constructing *Paddle Wheels for propelling boats, &c.;* John S. Greenough, Boston, Massachusetts, August 18.

"This wheel consists of an axle, arms, buckets with cranks, balance or guide wheels, latch bolts for bracing the buckets in their proper position, with lifters or followers for raising the latch bolt, and returning it to its place again, and friction wheels to confine the guide wheels in their place. The improvement here claimed is the manner in which the buckets are kept parallel, and either vertical, or at any angle, as deemed most efficacious in propelling."

A host of wheels have been contrived with a view to giving the paddles a vertical, or nearly vertical, position; and many of them have been tried at great expense, and have been abandoned; boats have been kept running for a considerable length of time with such wheels, with no other discoverable advantage than by more frequent want of repair, affording employment to the workman: one, or more, is now on trial in Europe, and flattering accounts of advantageous results have been received, but we are incredulous, and will not admit the testimony until it has been confirmed by time. The plan before us does not differ in principle from that adopted by others, but the mode of arrangement is varied, and for this the patent is taken. There have been some more simple, and some more complex; the particular difference between this and other members of the vertical paddle family, cannot be made clearly known without a full description and drawings, and these we promise as soon as it goes into successful operation.

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254. For an improved mode of applying the *Bow and Worm Spring to Saddles;* Jonathan Keedy, Russelville, Logan county, Kentucky, August 18.

In the kind of spring applied to the saddle, as described in the specification, there is no claim made to novelty, but only to the manner in which it is arranged; which, however, does not present any thing of apparent importance.

255. For improved *Tongs, or Grappling Irons, for raising bodies from under water;* Ebenezer and Thomas J. Lobdell, city of Boston, Massachusetts, August 18.

These grappling irons are constructed in several different modes, according to the nature of the article which they are intended to raise; those for bars of iron, for example, differing in certain points from such as are to take hold of large stones; the principal novelty about them consists in the addition of wings, or bearing frames; and these constitute the claim. We shall not attempt to describe the various forms of the instrument, for although there may be some novelty in them, it is not to be supposed that, in the numerous cases where such things have been required and used, they have not been differently constructed and adopted to the object in view.

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256. For improvements in *Wind Mills;* Ebenezer Sperry, Wenham, Essex county, Massachusetts, August 31.

In this wind-mill the power of the wind is to be obtained in a square building, or tower, which may be from ten to fifteen feet square, and from fifteen to twenty feet in height, and this is to be enclosed at its base by eight doors, through which the wind is to be admitted, and by which its force is to be regulated. There are to be partitions, or wing walls, extending out between these doors to catch and condense the wind. Within this building there is to be a vertical shaft, from which successive circles of arms are to proceed, one above the other, like the spokes of a wheel; of these circles there may be four, five, or more; to the arms are attached vanes, or oblique wings, standing in the position of the vanes of a common ventilator. These circles of vanes are to increase in diameter as they rise one above the other. In the drawing, the tower is represented as roofed in, and having openings on each side containing blinds. The claims are to,

1st. The aforesaid construction and arrangement of buildings, or of more simple and less expensive structures, presenting, in the manner aforesaid, an extended surface, for the purpose of condensing and concentrating the currents of air, and throwing the whole force thus concentrated and condensed, directly upon the arms of the wind-mill.

"2nd. A series of arms on the same vertical shaft, or axis, which, while they receive the whole power of the air condensed and concentrated in the manner and by the means aforesaid, operate so as, in a great measure, to equalize the action of said power, while, at the same time, by means of their peculiar structure as aforesaid, they present as little resistance to the air as possible.

"3rd. The means used for letting off an excess of wind, by waste gates and doors, and for increasing its power by the use of canvas, or sail cloth, or other suitable materials."

To a mill of this construction, the objections appear to us to be numerous, and of such a nature, as seem well calculated to render this uncertain power less efficient than in mills of the ordinary construction. The attempts at giving to wind-mills a form and arrangement which shall render this power more available than in the Dutch mill, have, we believe, been in all instances a failure. Such we know has been the case with the horizontal mills, generally, and these, we apprehend, are the second best. In applying fluids to move machinery, there is much loss of power from sud-

den and great changes of direction, and in the mill before us this objection is very far from being removed.

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257. For *self-loading and priming Fire Arms;* Silas Day, city of New York, August 31.

It is not necessary to give the claims in the present case, as these would afford no information respecting the construction of the parts referred to in it; nor do we think it necessary to attempt a description of an arrangement which we apprehend will share the fate of nine-tenths of the improved fire arms, which now stand upon the lists of the Patent Office.

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258. For an improvement in *Ship Building*; Samuel E. Howell, Vincent town, Burlington county, New Jersey, August 31.

The claim is to "the forming the bows of vessels of a large class, in a regular curve; without a cut water, and in forming the keel in the section of a cone." What is meant by forming the keel in the section of a cone, is, that it flares out on each side, so that it is considerably wider at its lower side, along its whole length, than it is where it joins the bottom of the vessel. The advantages assigned to a vessel constructed with a bow of a regular curve, and without a cut water, are, that she will answer more readily to her helm, and will bear more beam than one with a sharp bow; that her greatest breadth of beam may be far forward, which will give her a larger sailing floor: that she will turn to windward more readily than a sharp ship; will ride at anchor much easier; will not gripe, or shear; will bear to have her masts without rake, and that the sails will consequently set more fair to the wind. The advantage of the form of keel described, is said to be that when the ship keels over with the wind, the lee side will present a perpendicular side to the water, which will hold the better to windward; a few additional inches to the width of keel making up for the deficiency of the cut water to the forward keel. Let nautical men judge of all this.

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259. For a *Quadrant Hinge for Stoves*; Ebenezer Barrows, Boston, Massachusetts, August 31.

This is a very convenient affair for oven doors, the doors falling down, and presenting a useful horizontal hearth. The claim is to "the contrivance or structure described, as resembling the quadrant, somewhat, in form, applied to the purpose described. Also the improvement whereby the hinge is cast in one piece with the door-leaf, or damper; requiring only a mortise or jog in the door frame, to complete the hanging of the door-leaf, or damper. Also the combination of the above description of hinge with the improvement of casting it in one piece with the door-leaf, or damper.

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260. For an improved *Yoke for Horses or Oxen*; Gideon Hotchkiss, Windsor, Broome county, New York, August 31.

Should farmers in general adopt the yoke which forms the subject of this patent, the gratitude of the patient ox, will be fairly due to Mr. Hotchkiss. As yokes are generally made, it would seem that the same judgment had dictated their form which induced the Hibernian to declare that it was the nature of the beast to pull by the tail. This yoke is suspended and turns on pivots in a way which causes it to adapt itself perfectly to the

motions of the animal. The claim made, is to "the manner of combining the part which constitutes the collar, in the yoke described, with the branched yoke, or with the cross bars, by means of pivots, as set forth."

We have seen a yoke very nearly resembling this, described in a French work on agriculture; but the two are not identical.

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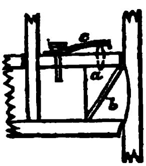
261. For an improvement in the mode of *Packing the Pistons of Steam Engines*; John Williamson, city of New York, August 31.

The piston is to have a cylindrical body, small enough to allow room for packing between it and the cylinder, plates of metal covering the upper and lower sides thereof, of such diameter as to fit the cylinder. Around the piston, between the two plates, there is to be a hoop of copper, the diameter of the upper edge of which is such as to extend to the cylinder, whilst its lower edge is in contact with the solid body of the piston, this hoop, therefore, being in the form of the frustrum of an inverted cone; it is cut through from bottom to top, to allow it to expand. A space *a*, will thus be left between the body of the piston and the copper hoop, and a space *b*, between the copper hoop and the cylinder, both of which spaces are to be packed in the ordinary way. Springs *c*, attached to the upper plate, press upon pins which communicate their bearing on to the packing in *a*.



The claim is to the combination of the conical hoop; the springs, packing rings, &c. with the other part of the piston, not being claimed as new.

The above arrangement does not appear to offer any thing superior to some other plans for giving elasticity to the packing of pistons.

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262. For a *Press for Hay, Cotton, &c.*; Jacob Grosvenor, city of New York, August 31.

In this press "the weight and accelerated gravity of a falling body are used to effect the compression of hay, cotton, hemp, or other similar substances. Such arrangement being used, when needful, in combination with a lever, in the form described, so as to diminish the length between the fulcrum and the working point of the lever, and thereby give an increase of power to the lever when the resistance is greatest." Such are the points claimed. A heavy follower, having a vertical rod extending to a considerable height above it, is to be raised by means similar to those used in raising the ram of a pile driver; and this is to be let fall upon the cotton, hay, &c. contained in a high vertical box; after which the follower is to be forced down by levers as indicated.

The idea of packing elastic fibrous material by means of a ram, is, we believe, new, and we also believe that it will be found to be worse than useless, as we do not entertain the slightest doubt that the time and power expended in raising the ram would effect twice as much in the process of packing in well known ways, as will be effected by the falling of the ram.

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263. For an improvement in the *Cooking Stove;* John S. Leavitt, Turner, Oxford county, Maine, August 31.

The claim is to "the combination and adoption of an open fire place with a cooking stove, having a furnace, oven, boilers, holes, &c. substantially as described:" which combination and arrangement differ sufficiently to sus-

tain the claim for a patent; but as to points of superiority, we have nothing to say, as the drawing and description do not render their existence very manifest.

264. For *Manufacturing Hydraulic Cements;* Ebenezer C. Warner, city of Albany, New York. Patent dated October 6th, 1837. (See Specification.)

265. For a *machine for Sowing and Spreading Lime, Plaster, &c.;* Levi Rice, West Chester, county of West Chester, Pennsylvania, August 31.

A circular, revolving table, or platform, is placed horizontally under the bed of a cart, at its rear end. It is made to revolve by a shaft connecting it with one of the driving wheels; a man in the cart, with a shovel, or otherwise, causes the article to be disseminated to pass through a hopper, or opening, upon the revolving table, whence it is thrown by the centrifugal force derived from its rapid motion.

The claim is to "the application of the centrifugal force to disseminate lime, plaster, &c. and small grain, in the manner described."

266. For an improvement in the *Machine for separating Smut from Wheat;* and for cleaning all kinds of small grain; Benjamin M. Smith, Rochester, Monroe county, New York. Patent dated August 1st.

The claim is as follows: "what I claim as my invention is the constructing a machine for cleaning wheat, or other grain, having a shaft with revolving disks, the upper surfaces of which are made rough by punching, or otherwise; which disks are surrounded by a case, the interior of which is also made rough by punching, and the insertion of metallic points in alternate sections, the whole constructed as set forth; also the vanes as combined with this machine, and the particular manner of forming the step."

Specifications of American Patents.

Specification of a patent for the manufacture of a Substitute for Gum Senegal, to be used in calico printing, and other processes; granted to Walter Leversidge, *Dorchester, Norfolk county, Massachusetts. Patent dated May 30th,* 1837.

To all whom it may concern, be it known, that I, Walter Leversidge, of Dorchester, in the county of Norfolk, and State of Massachusetts, have invented certain new and useful materials, prepared by a process herein described, and also a new and useful composition of matter, to be used as a substitute for gum senegal, and other articles of a similar nature, employed in calico printing: which composition of matter, when prepared for the calico printer, I denominate "factitious gum senegal powder," and I do hereby declare that the following is a full and exact description of the mode of compounding and preparing the same; and also of preparing a substitute for gum senegal from certain individual materials used in making the compound.

The composition consists of sago, potato starch, and lime, which may be combined together in variable proportions, but the best mixture is made in

the following relative quantities, or nearly so. I take forty parts of sago, fifty-five parts of potato starch, and five parts of quick lime, which ingredients I mix together, and reduce the whole to a fine powder. I then put this powder into an open vessel, and expose it to a temperature not exceeding 220° of Fahrenheit's thermometer, keeping it at this temperature until it has parted with all the water which it will lose at that degree of heat, and until the mass has become slightly discoloured; to insure an equal action of the fire upon the mass, the vessel must be so constructed as that its contents may be stirred, or agitated, during the process of desiccation. The vessel is then to be closed, leaving only a small aperture through which the acid and other vapours may escape, and through which the powder may be examined by the aid of a small spatula, to ascertain the progress of the operation. The heat is to be gradually raised until it approaches a temperature of 620°; this part of the operation requiring from three and a half to four hours, or a length of time sufficient to produce the proper colour, which is a dark orange brown.

The vessel is then to be uncovered, and the contents mixed intimately by stirring; it is then to be closed, and a stopper put into the small hole left for the escape of the vapours, and the heat continued as before, but not increased in any sensible degree; a reaction of the materials now takes place, the mass becomes somewhat adhesive, and exhibits an appearance of partial fusion. This is ascertained by occasionally removing the stopper, or inserting the spatula, when a portion of the mass will adhere to it. It is now to be removed from the fire, spread out thinly on a floor, stirring and turning it until it becomes cool. After this it is again ground, and passed through a fine sieve, or bolting cloth. The material is then ready for the calico printer, and is used for the same purposes, and in the same way, as the native gum senegal.

I sometimes use the potato starch, without the admixture of sago, or of lime, and I likewise sometimes employ the sago alone, treating them in the same way with the above named compound, and by this means produce a material which, although not equally good for all purposes as a substitute for gum senegal, will answer in some cases, and has not, to the best of my knowledge and belief, been heretofore applied to this purpose.

What I claim as my invention, and wish to secure by Letters Patent, is the preparing a substitute for gum senegal or other gums of a similar nature, by the calcination or roasting, of a compound of sago, potato starch, and quick lime, either in the proportions designated, or in any other proportions by which a substance substantially the same is obtained.

I also claim the preparing of a substitute for gum senegal, or others, &c. in some respects analogous to the foregoing compound, by the calcination or roasting of either sago, or potato starch alone, or in variable proportions, with or without the addition of lime.

WALTER LEVERSIDGE.

Specification of a patent for an improved mode of protecting the Metallic Sheathing of Vessels; granted to EDWARD M. ROBINSON, *New Bedford, Bristol county, Massachusetts, August 8th,* 1837.

Be it known that I, Edward M. Robinson, of New Bedford, in the county of Bristol, and State of Massachusetts, have discovered a new and useful improvement in the art of preserving copper, or other metallic, sheathing, from corrosion and waste, when applied to the sides and bottoms of ships or

vessels; and I do hereby declare that the following is a full and exact description of my process.

Take of paint by grinding pure verdigris in linseed oil, and diluted to a proper consistence to be applied to the sheets of metal, with a mixture of one gallon of linseed oil, and half a pint of a lacker prepared as follows: viz. by boiling together seven and a half gallons of linseed oil, four pounds of shellac, four pounds of red lead, and four pounds litharge until the shellac is dissolved.

Apply this paint with a brush to both sides of the sheet of copper or other metal intended to be used, and when dry, add one or more coats as may be desired. If it is wished that the paint should dry very rapidly, half a pint of spirit of turpentine may be added to every gallon of oil used in diluting the paint. When the paint is perfectly dry and hard, the sheets may be fastened upon the vessel's bottom in the usual manner. This paint may also be applied to metallic sheathing after it has been placed upon the bottoms of vessels; and it may also be applied to but one side of the metal before being fastened upon the vessel's bottom; but it is decidedly preferable to use it as first described.

What I claim as my discovery in the art of protecting the copper, or other metallic, sheathing of vessels from corrosion, is that by the application of a coating of paint, in which verdigris is the principal ingredient, to such metallic sheathing, in the manner above described, such protection will be effectually attained. I do not claim to be the inventor, or discoverer, of the above described paint, nor do I intend to limit myself to its application in the form prescribed, but to use verdigris mixed with oil, or varnish, in any of the modes in which a desirable paint is produced, in which the main body consists of verdigris, limiting myself to its employment for the purpose of protecting the metallic sheathing of ships, or vessels; such application being as I firmly believe new in the arts.

EDWARD M. ROBINSON.

Specification of a Patent for the employment of the Mineral called Basanite, in manufacturing Hydraulic Cement; granted to EBENEZER C. WARNER, *City of Albany, State of New York. Patent dated Oct. 6th,* 1837.

To all whom it may concern: Be it known, that I, Ebenezer C. Warner, of the City of Albany, in the State of New York, have discovered a new and useful mode of manufacturing Hydraulic Cement by the employment of the mineral called Basanite, Lydian-stone, and commonly called touch-stone. And I do hereby declare that the following is a full and exact description of my discovery.

The said material is to be burned in any convenient mass, in the manner of burning lime in kilns, in layers of wood and pit coal, with the mineral on the top, to a red heat, which may be continued six or eight hours.

After cooling, the said mineral is to be cracked, and then reduced to a fine powder, as impalpable as practicable. For this purpose it should be ground between stones of the ordinary size and kind, or any other process of pulverizing may be resorted to, by which the material may be reduced. This powder is to be mixed with water to a proper consistence for application to the purpose for which it is designed.

The said hydraulic cement, thus prepared, is similar in its qualities, and appliable to the uses of Roman cement (so called,) and being insoluble and indis-

tractable in water, and capable of resisting the action of, and exposure to, frost; thus becoming a paste cement, or mortar, for laying stone which is to be exposed to the action of water; a cement for cisterns, aqueducts, and securing cellars, or other excavations, below the surface of the ground, which require to be secured against the admission of water.

The analysis of Lydian-stone as ordinarily found, is as follows:

Silex	23.
Alumine	15.
Potassa	8.
Lime	.50
Oxide of iron	18.
Copper	24.
Water, carbon and loss	11.50
	100

What I claim as my discovery, and desire to secure by letters patent is, a new and useful mode of manufacturing hydraulic cement by the employment of the mineral called Basanite, Lydian-stone, and sometimes touchstone, as a principal ingredient therein. EBENEZER C. WARNER.

English Patents.

Specification of a patent granted to FLETCHER WOOLLEY, *for his invention of improvements in the manufacture or preparation of materials to be used as a substitute for bees-wax, parts of which improvements are applicable to other purposes.* Nov. 11, 1837.

The various substances employed in the different processes of this invention are comprehended under the following heads, and will be referred to in describing such processes numerically.

First, all kinds of animal and vegetable fats and oils, solid at the medium temperature of the surrounding atmosphere, which is about sixty degrees of Fahrenheit, as tallow and other animal fats, and palm oil, cocoa-nut oil, and other like vegetable oils commonly used for giving light by, or in, combustion. Second, all kinds of animal and vegetable elains and oils, liquid at the medium temperature of the surrounding atmosphere, as the elain of tallow, palm oil, cocoa-nut oil, seal, whale, sperm, and other oils used for affording light by combustion. Third, all kinds of naphtha, or coal, tar, oil, caoutchouc naphtha, or caoutchouc oil, gas oil, vegetable naphtha, or vegetable tar naphtha, and any other like naphthas or oils used as aforesaid, and commonly sold for that purpose. Fourth, pyroligneous naphtha or ether, correctly named pyroxylic spirit, sulphuric ether, and all other spirits or ethers of like nature. Fifth, all mixtures of the substances included under head the third, with those substances included under head the fourth, as two parts of coal naphtha or caoutchouc naphtha, with about six more parts of pyroxylic spirit. Sixth, resinous bodies and resins, as caoutchouc resin, mastic, copal, shel-lac, and others, and combinations of them with each other, as one part resin and four parts shel-lac melted together. Seventh, mixtures of the substances included under the heads third, fourth, and fifth, with the substances included under head the sixth, as thick solutions of copal in spirits, ethers, or naphthas, &c., and caoutchouc in naphthas formed by processes already known to the public. Eighth, certain solid bodies

separated from solid animal and vegetable fats and oils, as stearine, stearic acid, margarine, and margaric acid, adipocere, and others of like nature. Ninth, mixtures of the substances included under head the second, with the substances included under heads third and fifth, or three parts of cocoanut elain to one of naphtha, or to two of the substances included under head the fifth.

Firstly, palm oil of commerce is to be put into a shallow vessel made of copper tinned, or iron or other suitable metals, and raised to the temperature at which incipient decomposition begins and vapour flies off, at which temperature it must be kept for upwards of half an hour, and then allowed to cool gradually and undisturbed; by which process the stearine will crystallize more perfectly, and separate better from the elain. When sufficiently cold and solid, or about the consistence of old honey, it is to be put into bags or wrappers made of strong linen or sacking, or other suitable material, of such size and in such quantity that each bag or wrapper when filled shall be about two feet long, one foot wide, and one and a half inches thick, and in this state subjected to the pressure of a powerful hydraulic screw, or other suitable press (a ten-inch hydraulic ram has been used.)

This pressure is to be increased very slowly and gradually, and the material kept as nearly as possible at the medium temperature of the surrounding atmosphere, as long as any elain continues to ooze, by which process the greater part of the elain will be pressed out from the stearine.

The elain thus obtained is applicable to the purposes of burning in lamps to give light, and of lubricating machinery; and the stearine thus produced may be made into candles or other useful articles, or manufactured into a substance to be used as a substitute for bees-wax, as hereinafter described.

Secondly, any of the substances included under head the first, are to be melted and mixed in the fluid state, with any of the substances included under the heads second, third, ninth, and fifth, in a suitable vessel, and in the proportions of three parts of the former to one of the substances under heads third, second, and ninth, or to thirty or forty parts of the substances included under head the fifth, or in any other suitable proportions determined by the dissolving strengths of the substances included under heads second, third, fifth, and ninth; and the solidity and less solubility of the substances included under head the first, for they must be mixed in such proportions that the mixture shall be nearly of the consistence of old honey, at the medium temperature of the atmosphere.

When thus mixed, the mixture must be allowed to cool gradually and undisturbed, to favour the more perfect crystallization of the stearine, and to facilitate the separation of the elain; and when cold, and of the consistence of old honey, or thereabouts, it must be put into bags or wrappers and subjected to pressure, as hereinbefore described; by which process the elain will be pressed out combined with its solvent, and the stearine will remain in bags or wrappers.

The stearine can be made into candles or other useful articles, or manufactured into a substance to be used as a substitute for bees-wax, as hereinafter described; and the elain combined with its solvents may be applied to the purposes of burning in lamps for giving light, and of lubricating machinery.

Thirdly, any of the substances included under head the eighth, of which those made from tallow are best, are to be melted and mixed in the fluid state with any of the substances included under heads sixth and seventh, also melted in a fluid state in the proportions of three parts of the former to one of the

latter, or in any other suitable proportions, accordingly as the resulting compound to be used as a substitute for bees-wax is required more or less tenacious. For the smaller the proportion of any of the substances included under head the eighth, the stronger or more tenacious is the compound of the substances included under head the sixth; resin melted with four times its weight of shel-lac is best adapted.

It will also be well to state here, that shel-lac will not melt and mix with the substances included under head the eighth, unless previously united with the resin, mastic, or such like resin; and also that caoutchouc, copal, &c., will not unite well with the substances included under head the eighth, unless previously dissolved, as mentioned and contained under head the seventh.

Fourthly, any of the substances included under the heads third, fourth, and fifth, are to be mixed with any of the substances included under the heads second and ninth, in proportions varying according to the dissolving strengths of the former, or the soluble qualities of the latter, for the purpose of rendering the latter more liquid and better adapted for burning in oil lamps of common construction for the purpose of affording light.

Fifthly, any of the substances included under head the fourth, are to be mixed with any of the substances included under head the third, particularly coal, tar, naphtha, and caoutchouc naphtha, in the proportions of one part of the latter to three of the former, for the purposes hereinbefore mentioned, and for burning in common oil lamps to give light.

Journ. Arts & Sciences.

Specification of a patent granted to W. HEMPEL AND H. BLUNDELL'S *for preparing animal and vegetable substances for manufacturing Candles.*

This invention consists in operating upon palm oil, animal fat, or tallow and bees wax, in the manner and with the materials hereinafter set forth and explained, so as effectually to separate the stearine from the elain contained in the palm oil and animal fat or tallow, and convert the said stearine, by submitting it to the process of oxygenation, bleaching, and purifying, hereinafter described, into a highly improved stearic acid, which used by itself makes a very superior candle, or mixed with bees-wax enables candles principally made of that material to be run in moulds, instead of being dipped and rolled in the ordinary tedious manner.

As to the palm oil, the patentees say they subject this material to seven different processes—crystallization, pressing, oxydation or conversion of the stearine into stearic acid, separating the stearic acid from the lime, washing and pressing a second time, bleaching and refining.

First, crystallization; palm oil, as imported, is melted and run into large iron or other vessels, which are called crystallizing vessels; in these it is allowed to cool very gradually, the stearine crystallizes at a temperature of about seventy-five degrees of Fahrenheit, and the elain at this temperature partly separates from it.

Second, pressing; at about the last-named temperature, it is subjected to a powerful hydraulic or other mechanical pressure; the liquid part which runs from the press is the elain, and the solid substance which remains in the press is the stearine in an impure state, with a portion of margarine.

Third, oxydation or conversion of the stearine and margarine into stearic and margaric acid. The stearine and margarine are first melted in an iron vessel; to every 104 lbs. of the stearine and margarine, add, very gradually,

12 lbs. more or less, according to the quality of the ingredients, of very dry hydrate of lime in a very fine powder, keeping the mass briskly stirred during the whole time. The temperature is to be gradually increased to about 240 degrees of heat, and kept well stirred for about three hours, or until a perfect combination of the stearine and margarine with the lime takes place. This may be known by the mass becoming thin and transparent, and when cold, assuming a glassy appearance. This operation being finished, the fire is withdrawn, and cold water added very gradually at first, stirring very briskly all the while, until the whole mass falls into a state of coarse granulation, or powder; this is then passed through a wire sieve, to break down any lumps that may remain.

The patentees observe, that it may be as well to state how they prepare the said hydrate of lime, although this forms no part of the invention claimed. The lime-stone must be of the best quality, and free from flints: take pieces of such lime well burnt and fresh, lay them on a sieve, and immerse the whole in water for the space of one minute; take it out, and let the water that is not absorbed run off; the lime will soon fall to a powder; take this and put it into an iron vessel moderately heated, and covered down with a wooden cover, to drive away, by evaporation, any water that is free. It must then be passed through a fine sieve, and used as quickly as possible, as it soon attracts fresh moisture.

Fourth, separate the stearic and margaric acid from the lime. The stearine and margarine, by the last described process, has now become acidified or oxygenated in combination with lime, forming stearate and margarate of lime. Now proceed to separate the stearic and margaric acid from the lime. For this purpose muriate of lime is used, and sulphuric acid; take as much of the muriate of lime as will produce sufficient muriatic acid to decompose the quantity of stearate and margarate operated upon. To the muriate of lime, add as much sulphuric acid as will precipitate the lime and set the muriatic acid free. Put to the stearate of lime a sufficient quantity of this muriatic acid to dissolve all the lime contained in it, taking care to employ an excess of acid; the proportion will be about 3 lbs. of muriatic acid diluted with 9 lbs. of water to 1 lb. of lime.

This mixture is to lay three or four days, in order to ensure the complete solution of the lime; sufficient heat is afterwards employed to melt the stearic and margaric acids which then float on the surface. The muriate of lime is removed into another vessel, and decomposed with sulphuric acid; the disengaged muriatic acid is used in the next operation with stearate of lime, and so on. By this process the only expense of acid is the sulphuric, which is a saving of at least 50 per cent., with an almost perfect separation of the lime from the stearic acid.

Fifth, washing and pressing a second time. The stearic and margaric acids having been well washed with hot water, are again subjected to the press at a temperature of about seventy-five degrees of heat, to separate the stearic from the margaric acid.

Sixth, bleaching process. The stearic acid is taken from the press, and put upon water in large shallow vessels, placed in the open air, and kept at the melting point from eight to twelve hours, occasionally stirred, and exposed as much as possible to the action of the atmosphere, until it has become white. The margaric acid is bleached in the same manner, as above described, in separate vessels.

Seventh, refining process. It is then warmed again and removed in a melting state to a vessel which is called an agitating tub. To every 1000 lbs.

of stearic acid we use in this refining process 1 lb. of the black oxide of manganese, prepared from the white carbonate of manganese, or about $2\frac{1}{2}$ lbs. more or less, of the common black oxide of manganese, 40 lbs. of concentrated sulphuric acid, diluted with 200 lbs. of pure water; this solution, while warm from the heat which it evolves, is placed in a suitable vessel above the agitating tub; the stearic acid, being at the melting point in the vessel below the agitator or stirring shaft of this last named vessel, is set to work, and the solution is allowed to run gradually into it, until the whole is well mixed, which generally requires about two hours. The mass is allowed to lay in this state for forty-eight hours; it may then be boiled by steam for two or three hours, when it will be found to be sufficiently refined. The sulphuric acid which is at the bottom is now run off, and the stearic acid which remains is well washed with pure water; it is then put into large conical vessels of stone ware, enclosed in a box or jacket and kept warm by steam heat, and lined with conical bags of suitable strong, filtering paper, through which, being warm, it finds its way; and when the stearic acid has been thus filtered, it is run into blocks, when it will be found a beautiful stearic acid, which the patentees call palm stearic acid, or palm wax. It is then ready to be made into candles in the usual way.

Another mode is also proposed to be employed as a process of refining. To 100 lbs. of stearic acid add 16 lbs. of sulphuric acid, diluted with about 128 lbs. of pure water, or 21 lbs. of sulphate of manganese, and 9 lbs. of common salt. Boil these by steam for ten or twelve hours; or take about 10 per cent. of phosphoric acid, highly concentrated, or 10 per cent. of oxalic acid; boil in either case ten or twelve hours with steam. By using the phosphoric or oxalic acid, any earthy or metallic matters that might still adhere to the stearic acid, are effectually dissolved with more certainty than can be done by the agitator, unless the stirring shaft is very carefully and vigorously worked. And there is no extra expense of acids, as it is worked over and over again, being occasionally purified by the addition of a small quantity of sulphuric acid, which throws down any earthy or metallic matter the phosphoric or oxalic acid may have collected. The stearic acid, after having been well washed with pure hot water, is in this case also filtered as above, and run into blocks.

As to animal fat or tallow, the patentees proceed to describe the processes for the preparation of stearic acid from animal fat or tallow by crystallization. The animal fat or tallow is well cleansed from all impurities in the ordinary way; it is then, in a melted state, put into a round vessel, in which is a stirrer or agitator, and in which it is worked until it has cooled down to about 100 degrees of heat, when it will assume a milky appearance, with a granulated texture; the granulations are the stearine in a state of crystallization.

In this state it is put into the press, and subjected to a powerful pressure; the liquid which runs from the press is the elain or oil of tallow; the solid substance is the tallow stearine, for making candles when operated upon as follows:

Oxydation, or conversion of stearine into stearic acid. This process is exactly the same as is described for palm stearine. Separation of the stearic acid from the lime. This process is also the same as is described for palm stearic acid. Crystallization and pressing a second time; after the stearic acid has been well washed with hot water, it is again crystallized or granulated as before described, and pressed a second time. Refining process; the stearic acid is taken from the press, and refined by the second process des-

cribed for refining palm stearic acid; after being well washed with pure hot water, it is filtered as described for palm stearic acid, and cast into blocks ready to make into candles. Thus has the substance become good stearic acid, which the patentee calls tallow stearic acid.

Another mode of carrying on the process with animal fat or tallow is as follows:—Having crystallized and pressed as before, the stearine obtained is to be saponified by combining it with the caustic leys of soda, potash, or any other alkali; thus making stearate of soda or potash, &c. This stearate of alkali is dissolved in a vessel with hot water and steam; to this must be added as much phosphoric acid as will neutralize the alkali and set the stearic acid free. The stearic acid is put into an evaporating vessel with a heat of 180 degrees, and is left until the whole of the water is evaporated; it is again pressed, and, after having been well washed and filtered, is cast into blocks, and ready to make into candles. The phosphate of the alkali, is decomposed with quick lime, forming phosphate of lime and caustic alkali; the caustic alkali is again employed to oxydize a fresh portion of stearine; the phosphate of lime is decomposed by sulphuric acid, and the phosphoric acid is ready to be again employed by this method; the only loss is the sulphuric acid and lime, being about 3 per cent. of the alkali and phosphoric acid.

As to common tallow, mix therewith margaric acid from palm oil, prepared and bleached as aforesaid, in the proportion of 10 to 20 lbs. of margaric acid to 100 lbs. of tallow in the manufacture of common mould, or dip candles.

As to bees-wax; we will lastly describe our method of operating upon this article, which is simply mixing with it a portion of our palm or tallow stearic acid in its highly improved state, in the proportions of from 5 to 10 parts of stearic acid to 100 parts of wax, and then proceeding to make candles of the materials so mixed, by running them into moulds in the ordinary manner of making other mould candles. Ibid.

Specification of a patent granted to Alexander *and* James Dixon, *for their improvements in dyeing, by the application of materials not hitherto so used.* April 29, 1837.

This invention is comprised in a small compass. The patentees say, according to the ordinary processes of dyeing browns, greens, olives, Saxon blues, and blacks, a substance called "argal" (crude tartar) is employed as a mordant, as is well understood by dyers, which is an expensive material. Now, the object of this invention is to employ sulphate of soda as a mordant in the process of dyeing, in place of argal, by which the process of dyeing will be materially improved, both as to the cost and in other particulars.

The sulphate of soda is to be ground and sifted, in order to obtain it in the state of fine powder, similar to the condition in which argal is prepared for the dyer; and the subsequent treatment of sulphate of soda is similar to that pursued in preparing and employing argal as a mordant; and a dyer, acquainted with the ordinary process of using argal will, by substituting sulphate of soda, find the working of this invention easy to be performed; and he will find, that, in many respects, the colours will be produced more readily than when argal is used, and hence the time occupied in the dyeing with some colours be shortened.

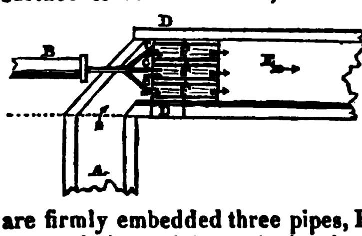
It should be remarked, that the sulphate of soda obtained from the nitrate of soda, is that which is most generally effective for the various colours above mentioned; but the sulphate of soda obtained from common salt (muriate of soda,) though less valuable, as requiring more observation and care of the dyer, may be advantageously employed for a mordant in dyeing heavy colours, particularly browns and greens. Ibid.

Specification of a patent for Improvements in the Manufacture of Carbonate of Soda; granted to FRANCIS GYBBON SPILSBURY *and* WILLIAM MAUGHAM. *Sealed Jan.* 11*th, and enrolled July* 11, 1837.

This invention relates, first, to a method of condensing the muriatic acid gas, which is now suffered to escape into the atmosphere with the smoke and vapour of the furnaces.

Secondly, to a method of obtaining carbonate of soda from muriate of soda without first producing a sulphate of soda, whereby the expensive and laborious processes of obtaining and decomposing that sulphate are avoided. It is well known that in order to condense the muriatic acid gas (which escapes so largely in that part of the process of making carbonate of soda, which consists in converting muriate of soda into sulphate of soda,) it is only necessary to bring the smoke and vapours, which issue from the reverberatory furnaces in converting muriate of soda into sulphate of soda, into contact with a sufficient body of water. But the smoke cannot be so treated without at the same time being cooled down, whereby the draft to the furnace is proportionably diminished. A high temperature is so necessary to the rapid and effective decomposition of muriate of soda by sulphuric acid, that manufacturers prefer occasionally paying damages for the nuisance they occasion to the neighbourhood, rather than to submit to the positive and daily loss which must be the consequence of any check to the draught of their decomposing furnaces; it is therefore desirable to render the draught of the furnace independent of the higher or lower temperature of the column of air contained in the chimney, a mode of accomplishing which constitutes the first part of our invention.

Description of the Drawing.—A, E, represents a section of the principal flue into which all the flues of the several decomposing furnaces of alkali work unite. It is bent at right angles, rising, as shewn, from beneath the surface of the earth. B, is a steam-pipe proceeding from a steam-boiler delivering steam of from ten to twenty pounds on the inch pressure. The pipe, B, separates into three branches, C, C, C, terminated by jets of about one-quarter of an inch aperture each. D, D, is a partition of brick or other suitable material which divides the flue, A, E, transversely. In this partition are firmly embedded three pipes, F, F, F, not exceeding four inches diameter, and about eighteen inches long, open at both ends. These pipes form the only communication whereby the smoke can pass from the part of the flue, A, to that marked E. The jets of the steam-pipes C, C, C, are inserted, as shewn, into the centre of the parallel, and opposite, open pipes, F, F, F; they enter about two inches, the smoke passing around them freely in its passage through F, F, F, in the direction of the arrows. The effect of this arrangement is that so soon as steam of from ten to fifteen



pounds on the inch is permitted to rush out of the jets, C, C, C, it communicates so great a velocity to the columns of air contained in the open pipes, F, F, F, that a most powerful draught is created in the flue, A, E, independent of any aid from the natural draught of the chimney. Although only three steam-jets and air-pipes are shown in the drawing, their number must be increased as the number of furnaces to be worked increases. The arrangement here described is sufficient for two large decomposing furnaces such as are ordinarily employed. Without exactly determining the number, which must depend upon circumstances peculiar to each manufactory, it may be generally stated, as a rule, that five air-pipes of four inch diameter, and five steam-jets of one-quarter of an inch aperture, projecting steam from ten to fifteen pounds pressure, will be found sufficient to work four large reverberatory furnaces more effectively than a chimney two hundred and fifty feet high. The end of the flue, E, is made to communicate with any form of condenser the manufacturer may choose, whereby the vapour and gas traversing the flue, may be brought into contact with a body of water sufficient to condense the aqueous vapour and absorb the acid, but as such condensation, and means for effecting the same, are well known, and as we do not claim any particular form, it is unnecessary to enter into a description thereof. After the smoke has been thus made to pass over the water, the uncondensable gases are to be carried into a chimney to escape in the ordinary way.

We will now describe our second improvement, which consists in a mode of producing carbonate of soda by converting muriate of soda into a fluoride of sodium or fluosilicate of soda (the latter is to be preferred as being the more insoluble,) instead of first obtaining a sulphate, as ordinarily performed in manufacturing carbonate of soda. For this purpose, concentrated fluoric acid, obtained from Derbyshire spar in any of the usual methods, and, as is well known, is to be mixed with its weight of muriate of soda, and so much water added as will prevent the muriatic acid from going off in the state of gas. There is then to be added sufficient ground flint, or other silicious matter, to convert the fluoride of sodium into fluosilicate of soda. The supernatant liquor, consisting of concentrated muriatic-acid holding a little fluosilicate of soda in solution, is then to be drained off. The remaining fluosilicate is then to be washed slightly with as little water as possible, after which it is to be transferred to a furnace, and subjected to a low red heat to drive off any adhering muriatic acid. The dry product is next to be mixed with double its weight of powdered chalk or limestone, and the whole boiled in water for several hours. The effect of this operation is a double decomposition, whereby the fluosilicate of soda and carbonate of lime are converted into fluosilicate of lime and carbonate and sesquicarbonate of soda, the latter being dissolved in the water. This supernatant liquor is to be drawn off, the residuum well washed, and the washings added to the first liquor, the whole is then to be evaporated to dryness, and the resulting product heated to redness. What remains is pure carbonate of soda, which may be redissolved in water and crystallized in the ordinary way. If instead of the fluosilicate of soda the fluoride of sodium is preferred, then the same process is to be gone through, with the omission of the ground flints, and the result will be fluoride of calcium and carbonate of soda.

Having thus described our invention, and the best means we are acquainted with for carrying the same into effect, we would remark in the first place as respects the condensation of the muriatic acid gas, we do not claim

any form of condenser, or any peculiar method of bringing the gas and smoke from the decomposing furnaces into contact with water; neither do we confine ourselves to the exact arrangements, herein described. But we claim, as the first part of our invention, the application of a jet or jets of steam playing into the flue or flues of the ordinary decomposing furnaces employed by alkali makers, for the purpose of impelling the column of vapour and gases contained within them, independent of, or in conjunction with, the ordinary draught of the chimney, when performing that part of the process of making carbonate of soda which consists in converting muriate of soda into sulphate of soda.

Secondly, we claim the treating of muriate of soda with fluosilicic acid in the manufacture of carbonate of soda, in place of converting muriate of soda into sulphate of soda, and then into carbonate of soda, as heretofore practised.

Reper. of Pat. Inven.

Specification of a patent for Smelting Iron with Anthracite Coal. Granted to GEORGE CRANE. *Sealed Sept.* 28, 1836, *enrolled March* 28, 1837.

According to the ordinary practice of obtaining iron from iron-stone, mine, or ore, in this country, the iron-stone, mine, or ore, either calcined or in the raw state according to its respective qualities is put into suitable furnaces, with coke produced from bituminous coal, formerly called pit-coal in contradistinction to charcoal produced from wood, which was the fuel employed in this country previous to the introduction of pit-coal, in the smelting and manufacture of iron. Now as there are districts in which are to be found large quantities of iron-stone, mine, or ore, in the immediate neighbourhood of what is known as stone-coal, or anthracite coal, it has long been considered as a desirable object to employ such coal for the smelting and manufacture of iron, and although attempts have been made to apply such description of coal in the smelting and manufacture of iron, the same have failed and have been abandoned. In addition to such advantages to be obtained from the using of anthracite or stone coal in the districts where such coal is found together with iron stone, mine, ore, from the practice I have had, I am induced to believe such coal from its properties, will be found to produce a quality of iron more nearly resembling iron obtained by the aid of vegetable charcoal. Now the object of my invention, is the application of such anthracite or stone coal, combined with a hot-air blast, in the smelting or manufacture of iron from iron-stone, mine, or ore. And in order to give the best information in my power for enabling a workman to carry out my invention, I will describe the process, or means, pursued by me, and in doing so, I will suppose the furnace of an ordinary construction to be in blast, and that the machinery and apparatus are adapted for the application of hot-air blast, as is well understood and extensively applied in many places where the ordinary fuel (coke of bituminous coal, or the coal in a raw state) is employed in the manufacture of iron from iron stone, mine, or ore, and I have found that a furnace having suitable apparatus for heating the blast to about 600 degrees of Fahrenheit, a good arrangement for carrying out my invention, though so high a degree of temperature is not indispensably necessary, but I believe preferable. In charging such a furnace, I throw in about 300 weight of anthracite or stone coal or culm, to each 500 weight of calcined argillaceous iron stone, with a proper quantity of flux as if working with the coke of bituminous coal, such charging of the furnace and the

general working, with the exception of the using of anthracite or stone coal, is to be pursued as if working with coke or bituminous coal, and I would remark that the quantities above given are such as I have hitherto employed in making the best qualities of pig-iron, videlicet, No. 1 or No. 2, at my works, from the anthracite, stone-coal, or culm, found in the neighbourhood of the Yniscedwyn Iron Works; but those quantities may be varied according to local circumstances, and the refractory nature of the iron-stone, mine, or ore, or otherwise to be reduced and the quality of iron desired to be obtained, as is the case in ordinary working, and at the judgment and discretion of the manager as heretofore. And I would remark that the anthracite or stone coal or culm, may be coked in like manner to bituminous coal before charging the furnace, but from my experience I have not (so far as my practice goes in working with the coal obtained in my neighbourhood) found that such coking is necessary, or that a more advantageous result is obtained than in applying the anthracite or stone-coal directly from the mine. And it is desirable to observe, I have found it of advantage that the blast of hot-air should be as free and unimpeded as possible, and from that account I have hitherto used only anthracite or stone coal, the smaller parts of which would not pass through a sieve of an inch mesh, but where the pillar or volume of blast is considerable, say two pounds and upwards on the square inch, this precaution is not necessary.

Having thus described the nature of my invention, and the manner of carrying the same into effect, I would have it understood that I do not claim the using of a hot-air blast separately, in the smelting and manufacture of iron as of my invention when uncombined with the application of anthracite or stone-coal and culm; nor do I claim the application of anthracite or stone-coal in the manufacture or smelting of iron, when uncombined with the using of hot-air blast. But what I do claim as my invention is the application of anthracite or stone-coal and culm, combined with the using of hot-air blast in the smelting and manufacture of iron, from iron-stone, mine, or ore, as above described. Reper. Pat. Inventions.

Progress of Practical and Theoretical Mechanics and Chemistry.

Notice on the Bichromate of the Perchloride of Chrome. By M. Walters.

I have constantly succeeded in the preparation of this compound by employing the quantities and process following: I placed in a tubulated glass retort 100 parts of sea-salt dissolved, and 168 parts of neutral chromate of potash, the whole being well mixed and reduced to a very fine powder; I then fixed to the retort a tube, and a receiver with two apertures, and poured by degrees, through a tube, in the form of an S, which was fixed in the aperture of the retort, 300 parts of concentrated sulphuric acid.

The liquor thus obtained is of a beautiful blood-red colour; it is volatile and sends forth vapour copiously; when placed in contact with a quantity of water, it falls to the bottom in drops of an oily appearance, and changes into chlorhydric acid and chromic acid; its boiling point is fixed and takes place at 118° Cent. under the pressure of $0^{m}\cdot76$; its specific gravity at the temperature of 21° Cent. is 1.71; it attacks mercury with great activity; for this reason all contact with this metal must be avoided; it is decomposed by sulphur, detonates with phosphorus, dissolves chlorine and iodine,

and combines with ammonia with a disengagement of light. A small quantity mixed with concentrated alcohol combines with a violent explosion and the inflamed alcohol is scattered with force. This unexpected action very nearly deprived me of my sight, and has burnt me in a most dreadful manner.

The bichromate of the perchloride of chrome is composed according to my analyses, of

Chlorine,	.	45.14
Chrome,	.	35.58
Oxygen,	.	19.28

This result agrees with that obtained by H. Rose, and with a combination calculated according to the formula $2\ Cr\ O^3 + Cr\ O^6$.

$$Cr^3 = 1055.457 = 35.37$$
$$Ch^6 = 1327.950 = 44.51$$
$$O^6 = 600.000. = 20.12$$

The density of the vapour deduced from observation gives $D = 5.9$; the value obtained by calculation by means of the formula $2\ Cr\ O^3 + Cr\ Ch^6$, is equal to $D = 5.48$.

3 vol. of chrone	.	11.6433
6 vol. of chlorine	.	14.6760
6 vol. of oxygen	.	6.6156
		32,9349

$$\frac{32{,}9349}{6} = 5.48$$

The analysis and the density of the vapour of the bichromate of the perchloride of chrome coincide therefore in representing this body as a combination of chromic acid and perchloride of chrome; its constitution may however be regarded in a different light, which, without being in contradiction either to the composition or to the density found, explains, in a certain degree better its remarkable characters and its little stability. Dr. Thomson having subjected this body at the time to analysis, had already offered quite a peculiar opinion on its constitution; he regarded it as being formed of chromic acid and of chlorine, and called it *chloro-chromic* acid; but this opinion could not withstand the objection of H. Rose, that with this supposition the combination must contain 10 per cent. more chlorine than obtained by analysis. But if instead of representing this combination as formed of chromic acid and chlorine, we look upon it as being formed of $Cr\ O^2$ and chlorine, the hypothetical radical $Cr\ O^2$ of chromic acid (itself expressed by the formula $Cr\ O^2 + O$,) acting the part of a simple body similar to the oxide of carbon and to benzoyl, this combination becomes analogous to the chloro-oxicarbonic acid, the chlorine occupying the place of the oxygen, which is not found in the radical of chromic acid. We may therefore represent this body by the formula $Cr\ O^2 + Ch$, which agrees both with analysis and with the density found. Indeed the analysis calculated according to this formula gives the following result:

1 atom of chrome	351.819	= 35.37
2 atoms of chlorine	442.650	= 44.51
2 atoms of oxygen	200.000	= 20.12
	994.469	100.00

And as to what concerns the density, calculated according to the same formula, we find

1 vol. of chrome	3.8811
2 vol. of chlorine	4.2890
2 vol. of oxygen	2.2078
	10.9809

$$\frac{10.9809}{2} = 5.49$$

But here each atom of the compound represents only two volumes of vapour. This body may therefore be regarded as a distinct acid, which might be named *chloro-oxi-chromic acid.* Recollecting that the perchloride of chrome does not exist in an isolated state, that analogous compounds are only produced by acids, which for one atom of radical, contain three atoms of oxygen, which are isomorphous with each other, and which may all be expressed after the hypothesis of M. Persoz, by the formula $R\,O^2 + O$, in taking into consideration the facility with which this body is decomposed when brought into contact with other bodies, and its little stability; this manner of regarding the constitution of this body, which explains its various actions, offers the appearance of much probability.

Lond. and Edin. Philos. Mag.

Preparation of Bicarbonate of Potash. By Prof. Wœhler.

Carbonate of potash, both in the dry state and in solution, combines very slowly with the second equivalent of carbonic acid to form the bicarbonate of potash. By means of charcoal in a finely divided state the combination may be made to take place very easily. It can be performed in the following manner: bitartrate of potash is to be heated in a covered crucible, the burnt mass to be moistened with water, put into a receiver, and carbonic acid passed through it. The absorption takes place with such rapidity that the mass becomes strongly heated, so much so that it is necessary to surround the receiver with cold water to prevent the reconversion of it into carbonate of potash. The saturation is complete when it ceases to give out heat. It is then dissolved in the smallest possible quantity of water at the temperature of 100° to 120° Fahr.; upon the cooling of the filtered solution, the greater part of the bicarbonate separates in fine crystals.—*Poggendorff's Annals.*

Lond. & Ed. Philos. Mag.

Preparation of Protoxide of Tin.

Owing to the great difficulty of preparing protoxide of tin according to the directions generally given in chemical works, I was led to make some experiments on the subject. I find the following process to be that which yields the purest oxide. Prepare a solution of protochloride of tin by dissolving the metal in hydrochloric acid, taking care always to have a great excess of the metal; the solution is then evaporated to dryness, together with a lump of tin to prevent the formation of perchloride. The tin is then separated, and the chloride weighed, and rubbed in a mortar with its equivalent, or rather more, of crystallized carbonate of soda; the mixture soon becomes fluid; it is then put into an evaporating dish and heated on the sand-bath, frequently stirring, till it becomes thoroughly black; it is then removed and well washed with boiling water, filtered, and dried at a gentle

heat on the sand-bath. The oxide thus prepared is of a beautiful blue-black or slate-colour; it is very soluble in hydrochloric acid, and when heated to dull redness in the air, it takes fire and burns, and is converted into peroxide. S. A. SANDALL.

St. Thomas' Hospital, January 3rd, 1838. Ibid.

Efficacy of Lightning Rods, or Conductors. By F. MACERONI.

I perceive that a question is mooted at the meeting of the British Association for the Advancement of Science, whether in the case of a certain "monument 140 feet high, erected on the summit of a mountain 1,400 feet high, augmented safety, or danger, would be the consequence of attaching to it a conductor or paratonnere?" I am induced to call the attention of your intellectual readers to this passage, as I am very sure that the subject is of great importance to society. About six months ago (vol. xxvi. p. 367) you honoured me by giving insertion to my account of a safety gunpowder magazine, in which I speak of lightning conductors, and to which I would request your readers to refer. There is just now a gentleman, one Lieutenant Green, of the Royal Navy, who is endeavouring to convince the public by his writing, that conductors are prone to cause the damage they are intended to avert. I must say, that I regard this statement as a mischief, for I have seen too much of the saving power of conductors not to wish that every house in Great Britain were protected by one.

Lieutenant Green, in his anti-paratonnere pamphlet, lately published by Tanner, of New Bond street, tells us of fifty churches in this country having been lately struck by lightning, because they had metal vanes! To be sure;—but metal vanes are not conductors; and conductors should not be formed of a wire scarcely bigger than a bell wire. In my above quoted article, I have stated, that a tube is better for a conductor than a solid rod, because it is to the surface of bodies that electricity adheres. Nothing could be fitter for the purpose than iron gas pipes; but their connexions and attachments, down the building, must be of stone, or other non-conducting materials.

Previously to the church of St. Peter's, at Rome, being protected by numerous conductors, by the French government, damage was continually being done to the upper part of that stupendous edifice; but never was the least injury inflicted after the application.

It must be borne in mind, that an elevated and efficient conductor will give its protection more frequently in perfect silence, and unobserved, than by conducting into the ground, or water, a positive discharge of electric matter, accompanied by a flash and thunder. The many-pointed conductors will silently draw off the electricity from a passing cloud, without any discharge, properly so called, so that the blow has been parried, if it be not a *bull* to say so, before it is struck.

During my several sojourns at Rome, I have made particular inquiries into the effects of lightning on St. Peter's church. After the numerous substantial, many-pointed conductors were affixed to the summit, and most prominent angles, of the church, by the French in 1808, an electric discharge was not known to have fallen upon it more than three times, and then it did no injury. It appears that the clouds, in passing over the church, are deprived of their plus electricity by the conductors, just as a Leyden jar is silently equilibrized by the presentation of a metallic, pointed conductor. How many ships would be saved from damage, conflagration, and, perhaps,

instant submersion, by properly constructed vehicles for conveying the electric fluid over the sides into the water? What inconvenience could be felt, from a branched rod and a chain from the mast-head, hanging along the shrouds into the water! All the failures of conductors arise from their want of sufficient mass of metal. A zinc chain, or tube, would be far less liable to oxidation than iron; and, as I have before remarked in the case of a powder magazine, &c., the metal might easily be kept with a clear surface, by an occasional rubbing with a brick-bat. About London we see conductors not thicker than a quill, applied to shot towers, tall chimnies, &c., whereas they ought to be gas tubes of at least an inch in diameter. The top ought to be formed in the manner of a branch of a tree, with five or six points of copper gilt, the extreme points being of pure gold or silver, as are those at Rome.

In some volcanic districts, over which it would appear that the solidified crust of our globe, which covers the yet incandescent mass, is thinner or more porous, than at other points, the electrical exchange of compliments between the earth and atmosphere, are almost as frequently directed upwards from the earth to the clouds, as in the contrary direction. Even against such upward discharges, the conductors, inserted in the earth, and ascending to the summit of the building, will preserve them from injury. I have witnessed a great many instances of ascending streams of electricity, some of which I have remarked upon in your pages, particularly in Nos. 401 and 402; and I am induced to think that we should see many more exhibitions of the process, were it not for the trees which act as silent conductors, both upwards and downwards. Electricity is the real food of plants, which they absorb through the innumerable points of their leaves and branches. On the same principle should a lightning-conductor be constructed with as many points as convenient.

Lieutenant Green says, "seventy-nine churches in Great Britain have in a few years been struck; some of them destroyed; many, after being furnished with from one to four conductors. All of those struck had metal vanes." How "many," out of the seventy-nine churches, were furnished with conductors, this opponent to Benjamin Franklin, does not tell us. He only shows the danger of metal vanes inviting the lightning, without a conductor to take it away. A bit of wire attached to the walls by iron eye bolts, or staples, is certainly more likely to cause mischief than to give protection. A proper and elevated conductor will generally carry off the electricity silently, without any apparent discharge.*

Lond. Mech. Mag.

New Experiment on Galvanic or Chemical action.

The following experiment is communicated to "The Annals of Electricity, Magnetism and Chemistry, conducted by William Sturgeon," by a correspondent whose signature is L. B. W.

"I took a smooth and clean piece of zinc, about the size of a walnut, inserted it in a piece of bullock's gut, and having carefully squeezed out all the air from the gut, tied it tight at both ends. I then placed the zinc, so surrounded by the gut, (into which there could be no mechanical possibility of entrance to the fluid,) into a jar of dilute sulphuric acid, and left it so all night. In the morning I found the gut full of gas almost to bursting. To prove the nature of the gas I made a pin hole in the membrane,

* *Note.* The above article is inserted because the fact stated respecting St. Peter's Church is deemed important; it otherwise assumes as facts what requires to be verified. *Ed.*

and, squeezing the gas through the flame of a candle, found, as I expected, that it was hydrogen.*

Here there could have been no voltaic influence; for zinc *alone* can produce none. Chemical it could only have been by the transmission of the acid; but the gut contained none. The zinc bore the same clean appearance as when first inserted, and was nowise oxidated.

"I repeated the experiment again and again, with the same result, excepting only that I found the inside of the bladder, or gut, and the zinc slightly moistened with a tasteless vapid fluid." L. B. W.

To W. Sturgeon, Esq.
&c. &c. &c.

The interesting facts above stated, appear to admit of satisfactory explanation from experiments made by the Editor of the Journal, and published in the first number of his Annals. He ascertained that different points on the surface of the same piece of metal are evidently in different states of electric polarity, and act towards each other, where connected by imperfect conductors, like the poles of a voltaic battery, producing a decomposition of the interposed fluids. There can be little doubt, therefore, that the moisture supplied by the gut was decomposed by the voltaic action of the zinc itself, the oxygen of the moisture combining with the metal, while the hydrogen escaped and expanded the enclosing membrane.

G.

Progress of Civil Engineering.

Asphaltic Mastic.

The ancients were indebted for the preservation of their buildings to the choice of their materials, and particularly to the use of cements, which, perfectly uniting with metal, stone, or wood, rendered their structures firm and solid. Amongst others, the use of a bituminous cement appears to have been extensive from the earliest times. Historians inform us, and modern observation confirms their statements, that the bricks with which the walls of Babylon were constructed were cemented together with hot bitumen. And in the destruction of some ancient remains of fortifications, supposed to have been Roman, near Pyrimont, about forty years ago, the stones appear to have been similarly cemented; and so great was their tenacity, that the works were with great difficulty pulled down, and not without the use of gunpowder. This circumstance led to a singular and important discovery, for the fact of which, as follows, we are indebted to a gentleman named Perrigny, a native of that neighbourhood. During the removal of the above ancient

*That animal membrane (bladder gut) has not only a permeability to fluid, but a power, by capillary attraction, of raising it two or three feet above its level, I call to witness my friend Goldworthy Gurney, who lately related to me the following experiment. Fill a glass funnel with water, and tie a fresh bladder over the large opening so securely that no water can escape; place it, with the bladder downwards, in a vessel (large dish) also full of water. Into the nozzle, or small end, of the funnel, a tube of 3 feet in length is to be inserted and secured quite tight by luting; set the apparatus thus arranged aside, and watching it, it will be found, said my informer, that the water will soon begin to rise in the tube, and ultimately reach the height of two or three feet.

remains, it was observed that the cement bore a great resemblance to the asphaltic mass or mountain in the park of Pyrimont, about five miles north of Seyssel. This led several persons present to think of making a similar application of it; amongst others was a relative of M. Perrigny, whose dwelling on the banks of the Rhone was so very damp, that the lower part could not be appropriated to any use whatever. This person considered that its application might succeed in keeping out the wet, every other remedy that he had tried having failed. The experiment was, accordingly, made, and succeeded beyond his most sanguine expectations. This circumstance, among other early trials of its properties, speedily led to its very general adoption in that vicinity, where the working of this material has become of great importance, and where the presence of the bituminous asphalte is so great as to appear almost inexhaustible, and, although but recently worked to any great extent, yet its properties as a cement appear to have been long known. It already constitutes the chief wealth of the country, which was previously half wild.

In various parts of the eastern chain of the Jura mountains, there are bituminous veins of greater or less extent; but the only place at present known where the asphaltic rock is to be found is at Pyrimont, above named in the department de l'Ain. In this immediate vicinity is also obtained a peculiar kind of mineral pitch, there called bitumen, which, upon being mixed in certain proportions with the asphalte, forms the mastic, or cement, of which it is our business to treat, and which, in France, after years of struggling with prejudices, and the opposition of parties interested in its failure, is obtaining so large a share of patronage as to be extensively employed both in the public and private works of that kingdom.

For many years after the discovery of the valuable properties of the asphalte, the mine at Pyrimont was the property of a company of Swiss merchants; but, from their defects of management, and from the limited extent of their finances, their operations were confined within very narrow bounds; and, at length languishing, the properties of the mastic were likely to have become lost to society. It, however, passed into other hands, among whom we find the English name of Taylor, and also of Mr. Equem, a gentleman who has persevered against all opposition in calling the attention of the French engineers and architects to the subject; and having executed a variety of works with unvaried success, has secured for it a rapidly advancing popularity in France, where we have lately had an opportunity of professionally examining and acquainting ourselves, not only with its nature, but also with its manipulation.

The business has now fallen into the hands of a private company at Paris, who, with a capital of 30,000*l*.; purchased the mine at Pyrimont, and are carrying on an extensive trade in its manufacture, with Mr. Equem at the head of the executive department.

The asphaltic mastic of Seyssel, when prepared for use, is, as before observed, a compound of two mineral substances; one is the native asphlate, the other is bitumen; the proportion of the former in the amalgum is 93 centimes, and of the latter 7 centimes. The asphlate is extracted from the mine in blocks, and reduced to an almost impalpable powder before it is mixed with the bitumen. The latter, as extracted from the mine, is first broken into pieces of about the size of an egg,

these are put into boiling water, and the particles which rise to the surface are purified by boiling for 24 hours: the result is, the bitumen to be mixed with the pulverised asphlate. The combination of these two substances forms the mastic or cement, which being reduced to a fluid state by the application of caloric, is poured into moulds of any shape required; or, in this state, used as cement in hydraulic works, &c. The use of the bitumen appears to be the giving of ductility to the mastic; and, if a very minute quantity of sulphur be added, the mastic will become hard, and partially brittle.

In France, where, with the exception, we believe, of Belgium, this mastic has, at present, only been employed, attempts have been made to imitate it; but in these fictitious compounds substances have been introduced, instead of asphalte, which absorb from 40 to 50 per cent of bitumen, forming a composition which the heat of the sun will melt, and which cracks when exposed to the cold of winter. In other instances, matter has been substituted which, having no affinity whatever for bitumen, disintegrates with time. When in Paris, we had an opportunity of making a fair comparison between the genuine and the fictitious materials. In the abattoir of Montmartre, one of the great public slaughter-houses of Paris, a part has been laid down with the mastic of asphalte, and another part with the fictitious mastic, both as substitutes for flag-stone pavement. For this purpose, perhaps a more severe test of their respective merits could not have been found, being exposed to the tramping of men and cattle, the dying struggles of the latter, with the blood and water with which it is constantly deluged. The flag-stone pavement hitherto used required frequent repairs and renewal; yet so great are the tenacity and hardness of the genuine mastic, that, although it had been thus in use for many months, it appeared as if it was new; whilst, on the other hand, the fictitious mastic had worn so much in holes as very much to resemble a honeycomb; and these holes being filled with blood and filth, presented to an unaccustomed eye a very disagreeable sight.

The genuine mastic possesses the hardness of stone, and yet preserves a certain elasticity. When used as pavement for terraces or footpaths, it appears to resist the wear equally well with granite; and, when prepared in the manner now adopted in Paris, it is difficult to distinguish it in such situations from that stone. One of the finest specimens of paving that ever came under our notice, and which, at first sight, we mistook for granite, is that on the north side of the palace and gardens of the Tuilleries: it is about 1100 yards in length, and 10 ft. wide; it is composed of the asphaltic mastic; and the joints, which transversely cross it the whole breadth, and which at present appear to divide the pavement into a number of large, equally sized slabs, are disappearing, by the mastic becoming more dense from the tramping of feet; so that this extensive piece of pavement will soon appear, from end to end, like one immense sheet of stone.

A few minutes after the mastic has been spread in a fluid state, it again takes its natural density, which is such, that, at the heat of 30° Reaumur (equal to 100° of Fahrenheit,) it resists all impressions from an ordinary force. Its extensive application to the covering of buildings, instead of tiles, slate, or lead, has induced the trial of experiments in France, by which it was ascertained that it is anti-electric, a property which it is desirable that all bodies should possess that are employed in roofing.

Its application, also, for the flooring of halls, passages, and apartments is no way dangerous on account of fire, as it is not inflammable, the quantity of pitch which it contains being so very small. For the floors of underground kitchens, &c., it is particularly applicable, it being warm, and keeping out all damp, as well as vermin and insects, which are frequently so abundant in such places. When employed in the construction of water tanks or reservoirs, it imparts neither taste, smell nor colour, to the water it contains. Arch. Mag.

On the Valuation of the Mechanical Effect of Gradients on a Line of Railroads. By Peter Barlow, Esq., F. R. S.

The exact amount of the influence of ascents and descents occurring in the line of railway, on the motion of a load drawn by a locomotive engine, having been differently estimated by different persons, the author was induced to investigate the subject. A few observations are premised on the erroneous assumptions which, he conceives, have in general vitiated the results hitherto deduced. The first of these is that the expenditure of power requisite for motion is equal to the resistance to inaction; whereas, it must always greatly exceed it. No account, he remarks, has been taken of the pressure of the atmosphere on the piston, which the force of the steam has to overcome before it can be available as a moving power. Another source of error has been that the statical and the dynamical effects of friction have been confounded together; whereas, they are the same in amount, only when the body is put in motion by gravity, but not when it is urged down an inclined plane by an extraneous force. In the latter case, these effects are no longer comparable; friction being a force which, in an infinitely small time, is proportional to the velocity, while that of gravity is constant at all velocities; or, in other words, the retardation from friction is proportional to the space described, while that from gravity has reference only to the time of acting, whatever space the body may pass over in that time. It is an error, to assume that the mechanical power of the plane is equivalent to a reduction of so much friction; for the friction down the inclined plane is the same as on a horizontal plane of the same length, rejecting the trifling difference of pressure; and the whole retardation in passing over the plane, or the whole force required to overcome it, is the same at all velocities, and by whatever force the motion is produced; but the assisting force from gravity is quite independent of the space, or of the velocity.

In the investigations which the author has presented in this paper, he assumes that equal quantities of steam are produced in the same time at all velocities; and he adopts for his other data, those given by Mr. Pambour in his Treatise of Locomotive Engines; he deduces a formula from which, the speed on a level being given, we may compute the relative and absolute times of a train ascending a plane; and consequently, also, the ratio of the forces expended in the two cases; or the length of an equivalent horizontal plane; that is, of one which will require the same time and power to be passed over by the locomotive engines as the ascending plane.

The next objects of enquiry relate to the descent of trains on an

inclined plane, and comprise two cases; the first, that when the power of the engine is continued without abatement, and the second, that when the steam is wholly excluded, and the train is urged in its descent by gravity alone. The author arrives at the conclusion, that in the first of these cases, when the declivity is one in 139, the velocity, on becoming uniform, will be double that in a horizontal plane; and that for a declivity of one in 695, the uniform velocity of descent will be one-fifth greater than on the horizontal plane; and this he observes, is perhaps the greatest additional velocity which it would be prudent to admit. A plane of one in 695 is therefore the steepest declivity that ought to be descended with the steam-valve fully open; all planes with a declivity between this and that of one in 139, require to have the admission of steam regulated so as to modify the speed, and adjust it to considerations of safety; and lastly, all planes of a greater slope than this last, require, in descending them, the application of the brake. Lond. Mech. Mag.

Defacing Public Buildings and other Objects.

In France and Italy, so strong is the admiration for public gardens, for statuary, and other works of art, that they may be exposed to the public for years together, without getting in the slightest degree defaced or destroyed; whereas in Great Britain every public edifice, monument, or iron railing, is more or less injured. If a gentleman, in the neighbourhood of a town give the public the privilege of walking through his grounds, he may expect to find the borders trod upon, and flowers plucked up, perhaps by the root, his trees cut or torn down, and every thing more or less destroyed. In one of the public gardens in a town on the Continent, a nightingale built its nest and hatched its young inside a bush, within reach of the public walk. A footman, servant to an English family resident there, observing the nest, seized it and carried it off. So strong was the indignation of the populace, who caught the offender in the act, that he was brought before a magistrate, and condemned to be drummed out of the city, with a label on his breast, intimating his crime; which was executed amid the hootings of the populace. Whatever virtues the people of Great Britain possess, they have yet to learn the practical principle, "Look at every thing, and touch nothing." We know of nothing that will operate as a cure, so powerfully as the establishment of schools for infant and juvenile training; and we appeal to facts in proof of this position.—*Stow's Training System.* Arch. Mag.

Railway Speculators.

Some extraordinary evidence was given, it is said, before one of the Parliamentary committees, as to the means used to obtain the amount of subscriptions required by the standing orders of the House of Commons. A Jew, whose name bore a resemblance to that of a great capitalist, signed his name for 25,000*l.* This individual had neither house nor lodging: he received 4*l.* for signing the deed. Persons were employed to procure signatures, who received 5*s.* for each, giving four to the signer, and keeping one for themselves. The names of the clerks were put down for 500 shares each. One man's name appears for 32,000*l.*, and another for 20,000*l.* A news-agent signed for 10,000*l.*, and his son for 3000*l.*, and one of the solicitors for 1000 shares. One of the secretaries to the company procured signatures to the extent of 215,000*l.*; another to the extent of 86,000*l.*; and a

third to the amount of 260,000*l.* Several of the directors, whose names stood for 10,000*l.* each, caused the figures to be altered to 20,000*l.*, on the day before the deed was sent to be deposited in the proper office.—*Observ.*

Min. Jour.

Important improvement in Beams for Building.

A beam of very extensive dimensions, without pillar or prop, has been erected at the Pottery Gas Works, across the whole span of the new retort house, which is fifty feet. There are few objects, perhaps, connected with mechanism more worthy of inspection as a matter of curiosity, or a proof of the stupendous power of mechanical skill and contrivance. Hitherto the plan for erecting beams has been without recourse to the aid of mechanism, but in this beam there is brought to a practical result the whole power and ability that the materials are capable of, at a great saving of expense. The whole is fire-proof, supporting an iron roof of twenty tons, whilst the beam itself weighs only two tons. It is made upon Witty and Co.'s patent principle. We are informed that two such beams as this would be quite sufficient to support a bridge of fifty feet span. We have often thought that a very great saving might be made in bridge building by something of this kind, whereby objects which usually cost thousands might be accomplished for as many hundreds. We would recommend this invention strongly to the notice of railway companies; for it appears to exhibit the very thing wanting in viaducts for railways, and would cost but a tithe of the expense of those massive structures. No proof can be more convincing as to its practicability and application to viaducts than this beam and roof.—*North Staffordshire Mercury.*

Farm. Mag.

Progress of Physical Science.

On the Cause, the Prevention, and the Cure of Cataract. By Sir David Brewster.

Having submitted to the Physical Section of the British Association an account of a singular change of structure produced by the action of distilled water upon the crystalline lens after death, Sir D. Brewster was desirous of communicating to the Medical Section some views which this, and previous observations, have led him to entertain respecting the cause, the prevention, and the cure of cataract, he makes the following observations.

The change of structure to which I have referred consists in the development of a negative polarizing band or ring between the two positive rings nearest the centre of the lens; the gradual encroachment of this new structure upon the original polarizing structure of the lens; and the final bursting of the lens after it had swelled to almost a globular form by the absorption of distilled water.

As the crystalline lens floats in its capsule, there can be no doubt that it is nourished by the absorption of the water and albumen of the aqueous humour, and that its healthy condition must depend on the relative proportion of these ingredients. When the water is in excess, the lens will grow soft, and may even burst by its over absorption; and when the supply of water is too scanty, the lens will, as it were, dry and indurate; the fibres and laminæ, formerly in optical contact, will separate, and the light being reflected at their surfaces, the lens will necessarily exhibit that white opacity which constitutes the common cataract.

This defect in the healthy secretion of the aqueous humour, as well as the disposition of the lens to soften or to indurate by the excess or defect of water, may occur at any period of life, and may arise from the general state of health of the patient; but it is most likely to occur between the ages of 40 and 60, when the lens is known to experience that change in its condition which requires the use of spectacles. At this period the eye requires to be carefully watched, and to be used with great caution; and if any symptoms appear of a separation of the fibres or laminæ, those means should be adopted which, by improving the general health, are most likely to restore the aqueous humour to its usual state. Nothing is more easy than to determine at any time the sound state of the crystalline lens; and by the examination of a small luminous image placed at a distance, and the interposition of minute apertures and minute opake bodies of a spherical form, it is easy to ascertain the exact point of the crystalline where the fibres and laminæ have begun to separate, and to observe, from day to day, whether the disease is gaining ground, or disappearing.

In so far as I know, cataract in its early stages, when it may be stopped or cured, has never been studied by medical men; and even when it is discovered, and exhibits itself in white opacity, the oculist does not attempt to reunite the separating fibres, but waits with patience till the lens is ready to be couched or extracted.

Considering cataract, therefore, as a disease which arises from the unhealthy secretion of the aqueous humour, I have no hesitation in saying that it may be resisted in its early stages, and in proof of this I may adduce the case of my own eye, in which the disease had made considerable progress. One evening I happened to fix my eye on a very bright light, and was surprised to see round the flame a series of brightly coloured prismatic images, arranged symmetrically, and in reference to the septa to which the fibres of the lens are related. This phenomenon alarmed me greatly, as I had observed the very same images in looking through the lenses of animals partially indurated, and in which the fibres had begun to separate. These images became more distinct from day to day, and lines of white light, of an irregular triangular form, afterwards made their appearance. By stopping out the bad parts of the lens, by interposing a small opake body sufficient to prevent the light from falling upon it, the vision became perfect, and by placing an aperture of the same size in the same position, so as to make the light fall only on the diseased part of the lens, the vision entirely failed.

Being now quite aware of the nature and locality of the disease, though no opacity had taken place so as to appear externally, I paid the greatest attention to diet and regimen, and abstained from reading at night, and all exposure of the eyes to fatigue, or strong lights. These precautions did not at first produce any decided change in the optical appearances occasioned by the disease; but in about eight months from its commencement I saw the coloured images and the luminous streaks disappear in a moment, indicating, in the most unequivocal manner, that the vacant space between the fibres or laminæ had been filled up with a fluid substance transmitted through the capsule from the aqueous humour. These changes took place at that period of life when the eye undergoes that change of condition which requires the use of glasses, and I have no doubt that the incipient separation of the laminæ would have terminated in confirmed cataract had it not been observed in time, and its progress arrested by the means already mentioned. Since that time, the eye, though exposed to the hardest work, has preserved its strength, and is now as serviceable as it had ever been.

If the cataract had made greater progress, and resisted the simple treatment which was employed, I should not have hesitated to puncture the cornea, in the expectation of changing the condition of the aqueous humour by its evacuation, or even of injecting distilled water, or an albuminous solution, into the aqueous cavity.

On Electrical Induction. *By* Michael Farraday, Esq., D. C. L., F. R. S., &c.

The object of this paper is to establish two general principles relating to the theory of electricity, which appear to be of great importance; first, that induction is in all cases the result of the actions of contiguous particles; and secondly, that different insulators have different inductive capacities.

The class of phenomena usually arranged under the head of *induction* are reducible to a general fact, the existence of which we may recognise in all electrical phenomena whatsoever; and they involve the operation of a principle having all the characters of a first, essential and fundamental law. The discovery which he had already made of the law by which electrolytes refuse to yield their elements to a current when in the solid state, though they give them forth freely when liquid, suggested to the author the extension of analogous explanations with regard to inductive action, and the possible reduction of many dissimilar phenomena to one single comprehensive law. As the whole effect upon the electrolyte appeared to be an action of the particles when thrown into a peculiar polarized state, he was led to suspect that common induction itself is in all cases an *action of contiguous particles*, and that electrical action at a distance, which is what is meant by the term induction, never occurs except through the intermediate agency of intervening matter. He considered that a test of the correctness of his views might be obtained by tracing the course of inductive action; for if it were found to be exerted in curved lines it would naturally indicate the action of contiguous particles, and would scarcely be compatible with action at a distance. Moreover, if induction be an action of contiguous particles, and likewise the first step in electrolyzation,* there seemed reason to expect some particular relation of this action to the different kinds of matter through which it was exerted; that is, something equivalent to a specific electric induction for different bodies; and the existence of such specific powers would be an irrefragable proof of the dependence of induction on the intervening particles. The failure of all attempts to produce an absolute charge of electricity of one species alone, independent of the other, first impressed on the author the conviction that induction is the result of actions among the individual and contiguous particles of matter, having both forces developed to an extent exactly equal in each particle.

The author describes various experiments, with the view of showing that no case ever occurs in which an absolute charge of one species of electricity can be given. His first experiments were conducted on a very large scale: an insulated cube, twelve feet on the side, consisting of a wooden frame, with wire net-work, every part of which was brought into good metallic contact by bands of tin foil, had a glass tube, containing a wire in connexion with a large electrical machine, passed through its side, so that about four feet of the tube entered within the cube and two feet remained

* Chemical decomposition by the electric current,—G.

without; but it was found impossible, in any way, within this apparatus, to charge the air with the least portion of either electricity.

For investigating the question whether induction is an action of contiguous particles, and for deciding that of specific inductive capacity, the author employed, in conjunction with the torsion balance of Coulomb with certain variations and additions (such as an electrometer,) a new apparatus, constructed for the express purpose. This apparatus consisted of two hollow brass spheres, of very unequal diameters, the smaller placed within the larger, and concentric with it; the interval between the two being the space through which the induction was to be effected. The apparatus had a tube in the lower part, furnished with a stop-cock, by means of which it might be connected with an air-pump, or filled with any required gas. In place of the lower hemispherical shell of air, occupying the interval between the two spheres, any solid dielectric, of the same form, such as shell-lac, glass, or sulphur, might be substituted. Two of these instruments, precisely similar in every respect, were constructed, and the author ascertained that the inductive power was the same in both, by alternately charging each, and dividing the charge with the other, and finding that, in all cases, the charge remaining in the one, and also that received by the other, was very nearly half the original charge.

The experiments on which the author principally relies, in support of the correctness of his views relative to induction being exerted in curved lines, are the following: a brass ball being laid on the top of an excited cylinder of shell-lac placed perpendicularly, the charge which a carrier ball received when brought to different points near to the brass sphere, was measured by means of the electrometer, and it was inferred, from the characters of the electricity, that the charge was one by induction, and, from its measure, that it proceeded in curved lines. By substituting for the brass sphere a disc of metal, above the shell-lac cylinder, it was found that when the carrier ball was brought near to the middle of the disc no charge was communicated, although a sensible one was obtained at the edge of the disc, and also at a point above its centre, further removed from the excited cylinder. Corresponding, and very striking, results were obtained when a brass hemisphere was placed on the top of the cylinder of lac. The charge communicated at the centre of the hemisphere was only one third of that obtained at the edge of its periphery; but by taking it at a point at some height above the centre, and consequently much further removed from the inducing cause, the charge was nearly equal to that of the periphery. Here, the author remarks, the induction fairly turned a corner, exhibiting both the curved lines or courses of its action, when disturbed from their rectilineal form by the shape, position and condition of the metallic hemisphere, and also a lateral tension, so to speak, of these lines on one another; all depending on induction being an action of the contiguous particles of the dielectric thrown into a state of polarity and tension, and mutually related by their forces in all directions. In the foregoing experiments the dielectric was air, but they were afterwards varied by substituting a fluid, as oil of turpentine, and likewise a few solid dielectrics, namely, shell-lac, sulphur, carbonate and borate of lead, flint-glass, and spermaceti; and with these, corresponding results were obtained. These results, the author considers, cannot but be admitted as arguments against the received theory of induction, and in favour of that which he has put forth.

In the course of these experimental researches, some effects due to conduction, which had not been anticipated, and which were similar to the

residual charge in the Leyden jar, had been obtained with such bodies as glass, lac, sulphur, &c. If the inductive apparatus, fitted with a hemispherical cup of shell-lac, after having remained charged for fifteen or twenty minutes, was suddenly and perfectly discharged, and then left to itself, it would gradually recover a very sensible charge; the electricity which thus returned from an apparently latent to a sensible state, being always of the same kind as that given by the charge. This return charge is attributed to an actual penetration, by conduction of the charge, to some distance within the dielectric at each of its two surfaces, and several experiments are adduced in support of this view. With shell-lac and spermaceti the return charge was considerable; with glass and sulphur, it was much less; but with air, no decided effect of the kind could be obtained. As this was an effect which might interfere with the results, in the method the author adopted for deciding the question of specific inductive capacity, and as time was requisite for this penetration of the charge, its influence on these results was guarded against, by allowing, between the successive operations, as little time as possible for this peculiar action to arise.

The author thus states the question of specific inductive capacity which he had proposed to investigate:—I suppose A an electrified plate of metal suspended in the air, and B and C two exactly similar plates, placed parallel to, and on each side of, A, at equal distances, and un-insulated; A will then induce equally towards B and C. If in this position of the plates, some other dielectric than air, as shell-lac, be introduced between A and C, will the induction between them remain the same? or will the relation of C and B to A be altered by the difference of the dielectrics interposed between them?

The experiments of Coulomb, from which it appeared that a wire surrounded by shell-lac took exactly the same quantity of electricity from a charged body, as the same body took in air, seemed to the author to be no proof of the truth of the assumption, that, under such variation of the circumstances as he had supposed, no change would occur. Entertaining these doubts of the conclusions deducible from Coulomb's result, he had the apparatus previously described constructed, as being well adapted for this investigation. After rejecting glass, resin, wax, naphtha, oil of turpentine, and other substances, as unfit for the purpose in view, he chose shell-lac as the substance best calculated to serve as an experimental test of the question.

For the purpose of comparing the inductive capacities of shell-lac and air, a hemispherical cup of shell-lac was introduced into the lower hemisphere of one of the inductive instruments, so as to nearly fill the lower half of the space between the two spheres; and their charges were divided in the manner already described; each apparatus being used in turn to receive the first charge, before its division with the other. As the two instruments were known to have equal inductive powers when air was contained in both, any deficiencies resulting from the introduction of the shell-lac would show a peculiar action in it, and if unequivocally referable to a specific inductive influence, would establish the point in question.

The air apparatus being charged, and its disposable charge being 290°, this charge was divided between the two. After the division the charge in the lac apparatus was 113°, and in the air apparatus 114°. From this it appears, that whilst, by the division, the induction through the air lost 176°, that through lac gained only 113°. Assuming that this difference depends entirely on the greater facility possessed by shell-lac of allowing or causing

inductive action through its substance than that possessed by air, then the capacity for electric induction would be inversely as the respective loss and gain; and assuming the capacity of the air apparatus as unity, that of the shell-lac apparatus would be $\frac{176}{113}$ or 1.55.

When the shell-lac apparatus was first charged, and then the charge divided with the air apparatus, it appeared that the lac apparatus, in communicating a charge of 118°, only lost a charge of 86°. This result gives 1.37 as the capacity of the lac apparatus.

Both these results, the author considers, require a correction; the former being in excess, the latter in defect. Applying this correction, they become 1.50 and 1.47. From a mean of these and several similar experiments, it is inferred that the inductive capacity of the apparatus having the hemisphere of lac is to that with air as 1.50 to 1.

As the lac only occupied one half of the apparatus containing it, the other half being filled with air, it would follow from the foregoing result, that the inductive capacity of shell-lac is to that of air as 2 to 1.

From all these experiments and from the constancy of their results the author deems the conclusion irresistable, that shell-lac does exhibit a case of *specific inductive capacity.*

Similar experiments with flint-glass gave its capacity 1.76 times that of air. Using in like manner a hemisphere of sulphur, it appeared that the inductive capacity of that substance was rather above 2.24 times that of air, and the author considers this result with sulphur as one of the most unexceptionable.

With liquids, as oil of turpentine and naphtha, although the results are not inconsistent with the belief that these liquids have a greater specific inductive capacity than air, yet the author does not consider the proofs as perfectly conclusive.

A most interesting class of substances, in relation to specific inductive capacity, the gases or aeriform bodies, next came under the author's review.

With atmospheric air, and likewise with pure oxygen, change of density was found to occasion no change in the inductive capacity. Nor was any change produced, either by an increase of temperature or by a variation in the hygrometric state.

The details are then given of a very elaborate series of experiments with atmospheric air, oxygen, hydrogen, nitrogen, muriatic acid, carbonic acid, sulphurous acid, sulphuretted hydrogen, and other gases, undertaken with the view of comparing one with another under a great variety of modifications.

In conclusion, the author remarks, "Thus induction appears to be essentially an action of contiguous particles, through the intermediation of which the electric force originating or appearing at a certain place, is propagated to or sustained at a distance, appearing there as a force of the same kind and exactly equal in amount, but opposite in its direction and tendencies. Induction requires no sensible thickness in the conductors which may be used to limit its extent, for an uninsulated leaf of gold may be made very highly positive on one surface, and as highly negative on the other, while the induction continues without the least interference of the two states. But with regard to dielectrics, or insulating media, the results are very different; for their thickness has an immediate and important influence on the degree of induction. As to their quality, though all gases and vapours are alike, what-

ever be their state, amongst solid bodies, and between them and gases, there are differences which prove the existence of specific inductive capacities."

The author also refers to a transverse force with which the direct inductive force is accompanied. The experimental proof of the existence of such a force, in all cases of induction, is, from its bearing on the phenomena of electro-magnetism and magneto-electricity, of the highest importance, and we cannot but look forward with the greatest interest to the promised communication in which these and other phenomena relating to this subject will be reviewed. Lon. & Ed. Philos. Mag.

Effect of Cultivation upon Climate.

The question of the tendency of cultivation, and more especially the clearing of forests, upon the temperature of countries, has been much discussed, but without those definite results, which a subject of so much interest naturally claims. Until meteorological statistics shall be more diligently and accurately preserved, which there is reason to believe will be the consequence of an increasingly enlightened and expanding system of legislation, this question will not be solved with the desired precision. No country in the world, is more favourable to its accurate solution than our own. In one respect, the means are at hand of throwing much light on this subject,—namely—whether, within the observation of the settlers of our new countries, there has been any diminution or increase of the level of the water of lakes and ponds, and the quantity which flows in rivers which can be ascribed only to the effect of clearing and cultivation.

In a memoir on this subject by M. Baussingault, a translation of which appears in Jameson's Edinburgh Journal, Jan. 1838, facts are detailed from which the author draws the following conclusions:—

1st. "That the extensive clearing of a country diminishes the quantity of running water which flows over its surface; 2dly, that it is impossible for us to determine, at present, whether this diminution is owing to a smaller annual quantity of rain, or to an increased evaporation of the surface-water; or to those two causes combined; 3dly, that the quantity of running water does not appear to have varied in countries which have not been subjected to any changes arising from the progress of cultivation; 4thly, that, independent of the preservation of surface water, forests husband and regulate their flow; 5thly, that cultivation, when established in an arid country, which is not covered with forests, dissipates a portion of its running streams; 6thly, that, in clearings which are purely local, springs may disappear, without there being any ground to conclude that the annual quantity of rain has diminished; and 7thly, that drawing our conclusions from the meteorological facts collected in equinoxial regions, we may presume that the extensive clearing of a country diminishes the annual quantity of rain which falls upon it."

M. Baussingault enjoyed extensive opportunities of observations in South America as well as in Europe. No traveller since the time of Humboldt, has turned to a better account such opportunities in connexion with the resources of science. He cites the following, among other cases.

"Oviedo,* who, towards the end of the fifteenth century, so often tra-

* His Historia de la Provincia de Venezuela, was published in 1823.

versed the valley of Aragua, positively affirms that New Valencia was founded in 1555, at the distance of half a league from the lake of Tacarigua; and M. de Humboldt found, in the year 1800, that the town was more than three miles (2700 toises) distant from its banks. The aspect of the district exhibits additional evidence of a great change. The rising grounds, which are somewhat elevated above the plain, maintain to the present day the name of islands, which at a former period, was most accurately assigned to them, seeing they were surrounded with water. The space which has been exposed by the retreat of the waters has been transformed into most fertile fields for the cultivation of cotton, sugar-cane, and the banana tree. These buildings which were reared in the immediate vicinity of the water are seen to be more and more forsaken by it. New islands made their appearance in the year 1796. An important military post in the shape of a fortress, which was built in 1740 in the island of *Cabrera*, is now situated on a peninsula. Lastly, in two islands of granite, those, namely, of Cura and of Cabo-Blanco, M. de Humboldt discovered, among the bramble bushes, several yards above the level of the water, deposits of fine sand, containing many *helicites*. Facts which are so speaking as these, and withal so well ascertained, could scarcely fail of exciting the ingenuity of the learned on the spot, in the way of supplying explanations of the remarkable change; and they all agreed thus far, that some subterranean conduit had been opened up, which allowed the waters to flow freely to the ocean. M. de Humboldt, when on the spot, paid all due regard to this supposition, and after an accurate examination of the localities, came very decidedly to the conclusion, that the cause of the diminution of the waters of the lake of Tacarigua was nothing more than the extensive clearing away of the woods, over the whole valley, during the course of the former half century. "In laying low the trees," he observes, "which covered the tops and flanks of the mountains, mankind, in all climates, are, at one and the same time, entailing two great calamities upon succeeding generations; they are producing a scarcity both of wood and water."

Since the time of Oviedo, who, like all the older chronologists, is perfectly silent concerning any subsidence of the water of the lake, the cultivation of indigo, sugar, cotton, and cocoa, had been carried to a great extent. In the year 1800 the valley of Aragua maintained a population as dense as that of any of the most populous portions of France. The smiling prosperity which existed in the numerous villages which teemed with its industrious population, could not be witnessed without the greatest satisfaction. Such was the prosperous condition of this charming country when M. de Humboldt was sojourning in La Hacienda de Cura.

After a lapse of twenty-two years, it was my lot afresh to visit the valley of Aragua. I fixed my residence in the small town of Maracay. I soon found that, for many years, the inhabitants had been remarking not only that the waters of the lake had ceased to subside, but, on the other hand, they affirmed they were very decidedly rising. The lands which had been formerly occupied in the cultivation of cotton were now submerged. The islands of Las Nuevas Aparecidas, which had risen above water in the year 1796, had now become shallows, which were dangerous for navigation. The tongue of land near to Cabrera, at the northern side of the valley, was now so narrow, that the smallest rise in the lake altogether inundated it; and a steady breeze from the north-

west was sufficient to submerge the road which led from Maracay to Nueva Valencia.

The fears, which for so long a time had annoyed the inhabitants on its banks, were now altogether changed in their character; and they no longer dreaded the entire disappearance of the lake. They were now anxiously considering if these successive invasions of the rising waters were about to overwhelm their properties; and those who had explained the previous diminution, by the existence of subterranean canals were convinced that they were now choked up, and that nothing would save them but opening the conduits afresh.

During the two-and-twenty years which had intervened, important political transactions had occurred. Venezuela now no longer belonged to Spain. The smiling valley of Aragua had been the arena of the most bloody contests, and war and death had desolated those happy scenes, and greatly reduced the population. On the first cry of independence, a number of slaves obtained their liberty by fighting under the standard of the new republic. Its wide spreading cultivation was neglected; the forest trees, so luxuriant within the tropics, had again in a great measure usurped dominion over that region, which its inhabitants, after a century of constant and painful labour, had reclaimed. During the growing prosperity of the valley of Aragua, the numerous streams which fed the lake had been arrested and employed in innumerable irrigations, and their beds were found dry for more than six months of the year. At the last epoch to which I have alluded, the streams being no longer so diverted flowed without interruption. Thus, then, during the progress and continuance of agricultural industry in the valley of Aragua, when the process of clearing was pushed farther and farther, and when cultivation in every shape was advancing, the level of the water gradually subsided. More lately, on the contrary, during a period of misfortune, and, we would fain hope, but temporary, when the clearing was no longer continued, and the cultivated lands have fallen back into their wild state, the waters having ceased to fall, and are now very speedily assuming a decided rising movement.

I shall now direct my remarks to another quarter, without however leaving America, in which we find a climate analogous to that of Europe, and where we traverse immense districts producing the most valuable grains. I shall direct attention to the higher lands of New Grenada, and to those elevated valleys, from 6000 to 9000 feet above the level of the sea, which enjoy, throughout the year, a temperature of from 58° to 62° Fahr. Lakes are frequent among the Cordilleras; I might easily dwell upon many of these, but shall bring under review only those which have been the subject of previous observations.

The village of Ubata is placed in the vicinity of two lakes. It is an important fact that, sixty years ago, these two sheets of water formed one only. The older inhabitants have observed the waters gradually diminish, and their shores extend themselves year after year. Fields of corn, of the greatest fertility, at the present time cover districts which thirty years ago were completely covered with water. The falling of the mean level of this lake will the more readily be credited by the consideration, that an occasional fall of three or four inches lays bare a great extent of surface. If we inquire in the neighbourhood of Ubata of any of the old men, who in their younger days were devoted to the chase, or if we examine the records of any of the different parishes,

no doubt will remain that numerous forests have been felled. The clearing still goes on; and it is equally certain that the retreat of the water has not ceased, though it does not advance so rapidly as it was wont to do.

It is hoped that such of the readers of the Journal of the Institute, as may have the means of obtaining correct information on a question of this nature, in the interior and particularly in the more elevated regions of the United States, will not neglect the opportunities they enjoy, and that the facts which they obtain, may be given to the public in that, or some other, Journal, so as to serve the purpose of accumulating evidence in relation to the meteorology of our country. G.

Meteorological Observations.

Although the hope was expressed in the Journal of the Institute, that all those Societies, Academies and Colleges which are provided with the instruments necessary in a series of meteorological observations, would advert to the interesting and important proposition of Sir John Herschel, of collecting the results of simultaneous observations from all parts of the world, (see Journ. Frankl. Inst. for Sept. last, p. 190, et seq.) and that they will be willing to use a little exertion, to comply with so reasonable and judicious a request, I have not yet had the pleasure of knowing that such observations were made during the late equinox, at any place in this vicinity, or State*. There may not have been time yet for the reception of any of the registers made in conformity to these suggestions; but it is hoped that they will be forthcoming. As an evidence of the interest which men of the highest rank in science (and it would be difficult to name one which stands higher than the proposer himself,) take in the progress of meteorology, I extract a portion of a lecture given by Professor Airy, (the present Astronomer Royal) at Neath on the 9th of September last, while on a tour in Wales. It was delivered by request, at the opening of the Scientific Institution in that town, and is replete with the most sensible remarks on the objects and duties which may most profitably engage the attention of such an Institution. G.

"Among the subjects of scientific observation to which the attention of persons in this neighbourhood may be called, is the general department of meteorology. Though much has been done in regard to observation, yet so little has been made out to place it in the rank of a science, properly so called (by the establishment of rules of any kind deduced from past phenomena, and which may be expected to hold in future ones) that I have great difficulty in pointing out any distinct course in which the efforts of persons willing to pursue this subject may be most advantageously directed. But there can be little doubt that regular observations of the barometer, thermometer, dew-point, actinometer, anemometer, electrometer, and rain-guage, would contribute to the establishment of empirical laws regarding the succession of phenomena at this place; and that the institution of observations simultaneous with those at other places would assist in determining the relations of the

* The only Register, in conformity to this plan, which I have noticed in the American Journals, is that contained in the Mathematical Journal, of the Flushing Institute, Long Island.

weather at different places depending on their respective localities, or the progress of a state of weather from one place to another. With reference to this matter, I would most strenuously recommend (even if all others be omitted) the making of observations at every hour during a day and a half at each of the solstices and equinoxes, in conformity with the plan sanctioned by Sir John Herschel. As to the classifications of, and deductions from, meteorological observations, I have no general rule to give, except that such classification be always made with reference to some preconceived theory or rule of some kind. If it does not appear that any irregularity follows, steadily, the conceived rule, some new one must be sought: but if an irregularity depending on this rule be detected, it will be best to subtract from every observation the corresponding amount of this irregularity, and then to examine the remainders with the view of discovering new laws of irregularity. For instance, if it should be found that, upon combining all the barometrical observations made at the same hours of different days, there was upon the whole a certain irregularity depending on the hour of the day, this might be subtracted from the observed heights, and the heights thus connected might be treated as if they had been so observed: if then, upon combining all at the same seasons of different years, an irregularity should be found, depending on the time of year, this might be subtracted: in like manner, if irregularities could be found depending on the moon's age, the moon's declination, the moon's distance from perigee, &c., these might be successively subtracted: and if after all these deductions there should be found a distinct relation between the height of the barometer and the state of the wind on the same day, or the day before, or the day after, a great step would have been made. But I mention these points merely as instances of the way in which I think it will be absolutely necessary to proceed.

"A class of observations, implying small expense and no great trouble, is the observation of the direction of the magnetic needle at intervals of five minutes throughout certain days, in conformity with the plan recommended by Gauss and Humboldt, and now acted on from the west of continental Europe to the east of Asia. It is known to you that the direction of the needle varies from year to year, from day to day, and from morning to afternoon; but it has also been found that it is subject to incessant irregularities from one minute to the next. In particular it has been remarked, that, when an Aurora Borealis was visible at one place, very great disturbances of the needle have been noticed at many other widely separated places in which the Aurora could not be seen. From the concurrence of the observations, as far as they have yet proceeded, this conclusion has been deduced: that the irregularities at very distant parts of the earth are strictly simultaneous in time, depending apparently not upon the time of day, or any other circumstance which distinguishes one place from another, but arising from some unknown causes which Humboldt aptly terms 'magnetic storms.' But are these storms universal? The observations of Glamorganshire may assist to determine this point.* And if so, what are they? Do they influence the weather, the state of health, or any other circumstance immediately affecting our bodily comforts? I know nothing which impresses the imagination more strongly than to find that we are surrounded by an agent, which, in the shape of

* A variation needle has, since the delivery of this address, been mounted at Neath.

magnetism is almost unperceived, but in the state of galvanism or lightning may be most powerful; and to know that even in its weakest state it is the part of a great system whose arbitrary laws are felt, with certainty and regularity, in its most distant region. It is like finding ourselves under the quiet espionage of a mighty government, whose motives of action we know not, but whose universality of power we feel most sensibly.

"For giving the due efficiency to the various labours of the members of the Institution, it will at some time be necessary to publish Transactions. Let it not be supposed that the Transactions of local societies are of small value, or unrespected in the world. The memoirs of the Manchester society may be cited as among the most valuable collections of local information and general science which we possess. The expense of such works in a cheap form, need not to be very great. Min. Rev.

On the increase of Temperature in the interior of the Earth.

M. Arago has lately communicated to the Academy of Sciences the result ofthe thermometrical observations which he made, on the first of May last, in the well which is now being sunk at the slaughter-house (Abattoir) of Grenelle. The boring has now reached the depth of 1312 English feet. The bed of chalk, in which they have for so long been engaged, is not yet traversed, but the numerous flints, which were unceasingly met with at lesser depths, have now disappeared. The city of Paris has determined that the boring shall continue to the depth of 2295 English feet, if the spouting water be not found sooner. It is presumed that the water which will issue from so great a depth will possess a temperature of between 93°2 and 95° Fahr., and, in that case, it might be employed for hot baths, &c. But however this may be, we shall now adduce the thermometrical observations which have been made at the depth of 1312 English feet. On the 29th of April, at 7 P. M., four instruments were sent down, viz. two of M. Bunten's self registering thermometers, one a *diversement* thermometer which M. Magus of Berlin had recently sent to M. Dulong, and another of the same construction manufactured by M. Walferdin. The two first were contained in a copper tube, in which they were secure from the pressure of the water; the third was open at the top, but in such a manner that the pressure could not alter its form; and the fourth was enclosed in a glass tube, which was hermetically sealed. These four instruments, after having remained for about thirty-six hours in the well or bore, were removed from it on the first of May about 7 A. M.; they then indicated the following temperatures:—

The first thermometrographe of M. Buten,	74°.3
The second, do.	74°.21
M. Magus' thermometer, à diversement,	74°.30
M. Walferdin's do.	74°.66

Assuming, then, 74°.3 Fahr. as the temperature at the depth of 1312 English feet, if you subtract from this number that of 51°.08 Fahr., which indicates the mean temperature of the surface of the earth at Paris, 23°.22 will remain for the increase of temperature, corresponding to 1312 English feet of depth, or, what comes to the same thing, 1°.8 Fah. for 101.2 English feet. If we take the case of the observatory as

the starting point for the temperature where it is at 53°.06 Fah., 21°.24 Fah. will then be given as the augmentation for 1222.5 English feet which corresponds to 103.348 English feet for each centigrade degree.

Mechanics' Register.

Russian Gold Mines.—Important Discovery.

The St. Petersburgh letters are much occupied with a discovery relative to the working of the Russian gold mines, which, if truly stated, may come to have some influence on the circulation of the precious metals. A letter of the 26th ult., says, "There has been found out, it is said, in the Ural Mountains, a new mode of extracting gold from the earth, sand, or ore. The sand, or earth, has been put into a blast furnace and melted, and the most extraordinary results obtained. By washing, the method hitherto pursued in Russia, one and a half zolotnicks of gold were produced, from 100 poods of sand, &c. the expenses were about covered; two zolotnicks per 100 poods were worth working. Fine sand, or earth, rarely produced more than three zolotnicks, and five zolotnicks were quite uncommon. By the new process, on 100 poods of melted sand, they obtained sixty zolotnicks in some cases; in others, forty to fifty zelotnicks, and on melting 100 poods of previously washed sand, they got forty to fifty zolotnicks, of gold. There is little doubt of the accuracy of these statements, but what the comparative expense of the two modes is I cannot tell you, nor whether the Ural grows sufficient wood for fuel, and whether coal can be found there. One pound Russian contains ninety-six zolotnicks; 100 poods are about 3.550lb. English weight."

The Editor of the Mining Journals adds:

The importance to be attached to the new process, by smelting, of extracting gold from the ores, or deposits, in the Ural Mountains, is so considerable, from the increased quantity obtained, as will be observed by reference to a paragraph, extracted from the columns of a contemporary, and inserted in our present number, that we are induced to direct the particular attention of our readers to the subject, while it will be our province to endeavor to obtain more detailed information of the plan adopted. The vast outlay of capital in Brazil, where attention has been directed to the gold districts, and the numerous veins which are found in Virginia and in the neighbourhood of Charlotte, in the United States, renders the subject one deserving of the first consideration. The process of smelting, as applied to gold ores, is not novel in theory, although we believe the present to be the first instance of its successful practical adaptation; and, if we are to credit the statement that the produce has been raised from five to fifty, or ten times the amount obtained, merely by the introduction of an improved mode of reduction, while the halvans, or refuse, have been found to contain a large produce, it is an epoch in mining, which will tend much to revive the spirits of the shareholders in the "Union Gold Mining Company," and others of a similar nature, and proves that this peculiar department of mining is in its infancy. We expressed our opinion at the time of the announced failure of the success of the "Union Gold Mines," that an improved mode, or one perfect in itself, so far as improvements then had taken place, would doubtless have yielded profitable returns, and we sincerely

trust, that the present discovery will be found applicable to the ores of America, which, however, are, if we mistake not, of a different character to those of the Russian possessions.

We have here, then, an additional evidence of the affinity and importance of science being combined with practice—of the association and the advantages derived from the application of chemistry to the operation of the miner; and hence further proof of the advantages which may be fairly calculated upon from the establishment of a "School of Mines."

New process for Extracting Gold.

To the Editor of the Mining Journal.

Sir:—The following information respecting the extraction of gold in the Russian dominions, I have lately received from an intelligent and well-instructed officer of mines in the Emperor's service, and as you are properly anxious to be informed on the subject, I send it to you:—

"Knowing very well the deep interest you take in all scientific discoveries, especially in the mining and metallurgical departments, I thought it might be agreeable to you to be informed of a new discovery made in the Uralian Mountains, in the method of extracting gold from the alluvial deposits. In the official letter received in Paris, I learned that the following curious comparative experiments were made in the extracting of the gold from the sand, by Mr. Anossott:—

1. "By the common method of washing used in all countries having gold (stream-work.)

1. "By the amalgamation—the method similar to that employed in Hungary in gold mines.

2. "By the damp way, or dissolving the sand in acids.

4. "By melting the sand in the blast furnaces.

"Those experiments were made by the order of the Minister of Finance, Comte Kancrin, to the end of ascertaining the exact quantity of gold contained in a given quantity of sand, and extracting the gold from the very middle of the grains.

"By the second method; they obtained eight times more gold than by the first (common system.)

"The third method produced four times more gold than the first; but by the fourth method, that is to say, by melting the sand, twenty-four times more gold was obtained than by the washing system.

"In that process, the produce of the melting is an alloy of cast iron and gold (fonte aurifere,) from which the gold is separated by means of sulphuric acid. By putting this last method into practice, we shall obtain yearly 8000 poods (sixty-two poods equal to one ton) of gold instead of 400, from the same quantity of alluvial deposit. But the conservatory principle, applied to the national wealth of the Government adopts the plan of only a moderate increase of the annual produce of gold, and securing thus a longer existence to the alluvial deposits."

The statement as to the difference produced by the modes of treatment may appear startling at first, but it may be considered as more probable if we take into account the nature of the substance in which the gold is enveloped. The produce of smelting, we see, is an alloy of cast-iron and gold, indicating that, as is very usual, the substance accompanying this gold is iron. Now, to say nothing of the very imper-

fect results which can be obtained by the old method of washing, if we consider the ingenious application of amalgamation which is mentioned, we shall at once perceive, that every particle of gold which is wrapt up in iron must infallibly escape the action of the mercury, and it is not difficult to imagine, that a very considerable proportion may be so defended. Let the whole, however be reduced by fusion, and all the metallic part will then be brought together and separated at once from the earthy part, and consequently, little or none of the gold can escape. Thus, we may account for a very considerable difference in the results of the processes that have been employed. The separation of the gold from the iron by sulphuric acid, is not likely to produce any waste of the precious metal.

It is anticipated, I know, that this improvement may be extended to other gold-producing countries, and I have no doubt but it may in due time; but it should be recollected, that smelting is a very expensive and tedious process in some of these countries, partly from scarcity of fuel, and partly from very imperfect methods for producing the necessary blast, by which it happens that the degree of heat required is difficult to obtain. Improvements may be made so as to remedy some of these defects, and one important one, I believe, would be, the application of the hot air blast; but those who know what the difficulties are in making alterations in established processes in some of the countries to which these observations are applicable, will see that considerable time may be required to accomplish the object, and the selection of very judicious and well instructed agents to carry the necessary measures into operation.

To any one who may be considering the subject with a view to adopting the use of this discovery, I would also suggest, that the chemical separation of the metals, is an operation which must be directed by one possessed of considerable skill and experience, and that it can only be done where sulphuric acid, or substances not easily transported, can be supplied in sufficient quantities. If the alloy be rich enough to bear the charge of carriage it might be better to send it to places where the requisite skill and materials can be had with facility, but here again, the fiscal regulations of different countries may oppose an obstacle.

I merely throw out these hints that persons who may wish to avail themselves of the advantages held out by this process, may be prepared to meet the difficulties that present themselves, and to set about the undertaking in a manner most likely to ensure success.

I am, Sir, your obedient servant,

Chatham place, July 6. JOHN TAYLOR.

Smith's Ever-pointed Stone-Cutting Chisel.

The ordinary chisels used for dressing and cutting stone very frequently want sharpening, which is an operation requiring time, judgment, and expense; having, when blunted, to be forged and sharpened, and afterwards hardened and tempered. A machine maker of the name of Smith in this town has lately invented an ever-pointed chisel, which will I think soon be generally adopted, provided it be made cheap. It is in fact an application of the principle upon which Messrs. Mordan's

(or rather Mr. Hawkins') ever-pointed pencil is constructed. A thin plate of well tempered steel, of the width of the chisel required, is placed between two cheeks of iron, and held tightly between them by means which I shall describe. The point of the thin steel projecting beyond the ends of the iron cheeks, forms the cutting edge of the chisel; and as soon as the edge which projects is worn away by the friction of the planing stone, the steel is advanced between the cheeks, and the edge is thus immediately renewed. To prevent the steel plate from slipping side-ways, there are studs on each side of it, on one of the iron cheeks, which go into corresponding holes in the other cheek. The whole is held together by a collar or mortise slipping over, and hammered up tightly, the cheeks being of a wedge shape. When the mortise, or collar, is driven properly home, a groove therein coincides with a groove in the cheek of the chisel, and a wedge being put into the hole thus formed, holds the whole chisel tight, and prevents the mortise from being shaken off by the blows of the mallet.

At the top of each cheek, on the inside, is the half worm of a screw; between these, a screw is inserted, the end of which touches the top of the steel plate, and on being turned down with a screw-driver, or otherwise, forces the steel out from between the cheeks for renewing the working edge.

I hope I have described the thing clearly enough to be understood by my brother masons and your readers, without the aid of a drawing; my hands are too rough and stiff with handling the mallet and chisel, and moving our hard native stone, to attempt the draughtsman.

I am, Sir, yours respectfully,

A Stonemason.

Bradford, Yorkshire, Nov. 28, 1837. Mech. Mag.

British Enterprise Abroad.

The traces of British capital are to be met with everywhere abroad. Most of the cities of Europe which enjoy the "new light" of the nineteenth century are furnished with it by "The British Continental Gas-Association," and Paris itself is about to be supplied with water on the English plan, by a Company of which the shares are in a great measure held by Englishmen. A "Sardinian Mining Company" has recently been established, for the purpose of working a number of mines in the Savoy, which are said to be exceedingly rich, and to offer very peculiar advantages. The proprietors are English, and they propose to smelt the ore by a new English process. The whole of the mines, of silver, copper, and iron, in the Duchy of Nassau, have been leased to an English association, who expect to reap important advantages from the application of a greater degree of skill and capital to the works than has ever hitherto been bestowed upon them. It is said that the total number of mines in the possession of this Company is upwards of two hundred and eighty! Ibid.

Manufactures of Lancashire.

Probably the largest entire room for manufacture in this county, and if so, in Europe, is that of Messrs. T. and E. Grundy, at Heap Bridge, near Bury. It is appropriated to the manufacture of wollens, and is 85 yards in length by 75 in width, and 12 feet in height; is supported by 253 pillars, some of which also bear gearing; it has 65 large windows, and 253 skylights; 672 feet of steam piping run through it; about 2,688 feet of shafting are at work. It contains, or will contain, eight carding engines, probably the largest in this county; eight gigantic slubbing frames; 40 mules; 200 looms, some for weaving prials, three in width; 450 gas jets; will be worked by one engine of comparatively small power, and is surmounted by a funnel of 69 yards and two feet.—*Bolton Free Press.*

Mech. Mag.

Flint in Wheat.

The scoundrels who burn wheatstacks in the country leave behind them some curious chemical results. "Swing" is a grand experimentalist. There are found in the embers lumps of coarse glass, which are the result of the fusion of the silicia, or flint, which wheat straw in particular is found to contain in very considerably quantities.

Min. Jour.

Iron.

The quantity of iron made in this country during the year 1836, has been estimated at the enormous quantity of a millon tons; the average price of pig-iron for the year being about 7*l.* per ton, and that of bar-iron about 11*l.* per ton.

Ibid.

LUNAR OCCULTATIONS FOR PHILADELPHIA, AUGUST 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
3	9	3	Im. p Sagittarii	,6,	137°	119°
3	10	7	Em.		241	235
14	13	37	N. App. ☽ & C Tauri 4, 5, ☽ North 3′, 9			
24	1	10	Im. α Virginis,	,1,	51	25
24	2	32	Em.		227	220

The meteorological table for this number, not having been received from our correspondent, the publication of it is necessarily postponed until the next number.

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AMERICAN PATENTS, LIST OF, WITH EDITOR'S REMARKS, &c.

A.

JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania

AND

MECHANICS' REGISTER.

DEVOTED TO

MECHANICAL AND PHYSICAL SCIENCE,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

BY THOMAS P. JONES, M. D.

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1838

JOURNAL

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FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

JULY, 1838.

Practical and Theoretical Mechanics and Chemistry.

Brief Observations on Common Mortars, Hydraulic Mortars, and Concretes; with some Experiments made therewith, at Fort Adams, Newport Harbour, R. I., from 1825 *to* 1838; *by J. G. Totten, Lt. Col. of Eng. and Brevet Col. United States Army.*

SECTION V.

ARTICLE XXIII.—*On Lime, Hydraulic Cement, Sand, Mortar making, Strength of Mortars and Grout.*

(CONTINUED FROM VOL. XXI., PAGE 383.)

During the progress of operations under my direction in the construction of Fort Adams, in Newport Harbour, Rhode Island, many experiments were made with mortars exposed in the air; giving, in some cases, results quite interesting. The results are too limited in number and restricted in variety, to justify the deduction of general principles; still they afford some hints that may be deemed worthy of being followed up.

The following tables contain these results in a very condensed form; but before giving the tables, it is proper to make some observations on the materials employed—the manner of using them, and the modes adopted of trying the relative strengths of the essays.

Lime.—Three kinds of lime were used, namely:

1st. "*Smithfield Lime.*"—From Smithfield, R. I. about fifteen miles from Providence. This is a very fat lime—slaking with great violence, when properly burned, and affording a large bulk of slaked lime.

2d. "*Thomastown Lime.*"—From Thomastown (Maine.) This is also a fat lime, at least so far as it has been tried at Fort Adams: but it is probable that some of the many varieties—including those of the neighbouring towns of Lincolnville, and Camden, may prove to be hydraulic. The richer varieties slake promptly, giving a large bulk of slaked lime.

3d. *Fort Adams Lime.* This is made from a ledge of whitish transition limestone found within the domain of the Fort. The stone is very fine grained and compact, exceedingly difficult to break, and crossed in all directions by three veins of whitish quartz. The ledge is a bed, or large nodule, in graywacke-slate. After calcination it yields, by sluggish slaking, a lime decidedly hydraulic. A little of this lime, after being slaked, was made into a cake of stiff hydrate; the excess of water being absorbed by bibulous paper: the cake was placed in the bottom of a tumbler and covered immediately with water. In about $7\frac{1}{2}$ days, a wire $\frac{1}{21}$ of an inch in diameter, loaded to weigh 1 lb., made no impression on this hydrate.

Three modes of slaking the lime were tried in these experiments, namely:

1st. *Slaking by Sprinkling.*—In this mode, water, in quantity sufficient to slake the lime to dry powder, but not enough to afford moist powder, was sprinkled upon the lime. The lime was not made into mortar until it had become cold.

2nd. *Slaking by Drowning.*—In this mode, water enough was given, in the first place, to reduce the lime to a cream of such consistency as to afford mortar of proper "*temper*" for common use without any further addition of water, provided the mortar was made up immediately. If the making the mortar was delayed, a further supply of water became necessary.

3d. *Air-slaking.*—In this mode, lime, reduced to pieces about the size of a walnut, was left in the air to slake spontaneously.

These were the processes by which the lime used in the experiments was slaked: but by neither of these, nor by any modification recommended by others, or that we, ourselves, could devise, were we able to free the hydrate from an infinity of small particles of lime, that being imperfectly, or not at all, slaked in the first instance, it was almost impossible, by any amount of labour afterward, to break down and mix with the rest. The mortar mill, hereafter described, reduced these refractory particles better than any of the ordinary modes of acting upon lime; but not sufficiently, without an unwarrantable amount of labour. All other means having failed, resort was had, at last, for the mortar for the masonry of the Fort, to grinding the dry lime to a very fine powder between millstones. Lime thus ground gives a perfectly homogeneous mortar: and some partial experiments lead to the opinion that the gain in the quantity of lime available for mixtures with sand, will, nearly if not quite, compensate for the expense of grinding. So far as the mortar thus made has been tried, the results were favourable: but the experiments on the quantity and quality of lime thus treated, though they justify confidence, are not, yet, so conclusive as to warrant any positive assertions.

Hydraulic Cement.—Three kinds of hydraulic cement were employed—namely, a kind that will be here designated as *hydraulic cement A*, which was supplied from the State of New York—another kind, called *hydraulic cement B*, supplied from a different manufactory in the same State—and "*Roman (or Parker's) cement,*" imported from England.

The experiments will show a material difference in the respective qualities of these hydraulic cements. According to them, cement A was the best, cement B the next best, and the "Roman cement" the worst; but it must be remarked that the last mentioned had, no doubt, greatly deteriorated, from imbibing moisture during a long voyage, and long keeping in store; while there is reason to suppose that the two first mentioned had been calcined within a few weeks. Between these two, there was also a marked difference; but though the superiority of cement A was probably in part

intrinsic, it was, no doubt, in part, to be ascribed to its greater freshness. These cements, therefore, should, in our tables, be compared with themselves under various combinations with other ingredients, rather than with each other.

This is perhaps the best place to mention a very certain and satisfactory mode of testing the hydraulic quality of lime or cement. It is derived from Raucourt's work on mortars.

Of the lime or cement to be tried, a cake of quite stiff hydrate must be made of a size to lie, without touching the sides, in the bottom of a tumbler: any excess of water should be absorbed from the cake by bibulous paper, until it will just support a wire $\frac{1}{12}$ of an inch in diameter loaded to weigh $\frac{1}{4}$ of a pound—this wire should barely make its impression. Noting the hour and minute of the watch, the cake, thus prepared, should be placed in the tumbler, and covered immediately with water. If the specimen be very hydraulic, it will set almost instantly; if not very hydraulic, it may require days, and if but slightly hydraulic, it may require weeks to harden. In order to have some invariable measure of what we call *setting*, we have always used a wire $\frac{1}{24}$ of an inch in diameter, loaded to weigh 1 pound.

With these two simple instruments, and these simple appliances, the comparative hydraulic qualities of limes and cements may be detected infallibly. It may not be strictly accurate to say that those cements which indurate most promptly under water will afford the strongest mortars in the air; although that has, for the greater part, appeared to be the case, in our experiments; still it is highly probable that such cements will be found among the best; it is, at any rate, amongst such that we should look when in search of mortars of superior excellence; and it is undoubtedly true, that when hydraulic qualities exist in lime, although in feeble proportion, the lime is essentially benefited. A simple means of testing hydraulic quality is therefore of value.

Our experience has, however, taught us one important caution in the use of this test; which is, to leave the cement in the water for a day or two, although it may have set in a few minutes. A cement was under trial which, at the expiration of 7 minutes had set so as to bear the small wire with the weight of 1 pound—and at the expiration of 15 minutes, with the weight of 2 pounds. In about two hours, however, it was entirely soft again, having been broken down by the slaking of some free lime that happened to be present, and which had not had time to slake before the hydraulic ingredients had indurated. After about fifteen hours it was taken out of the water, restored to the condition of stiff mortar, and again immersed. It now hardened very slowly, and was six days acquiring the test hardness. Such cements require peculiar treatment. It is evident that there is great hydraulic energy wasted in the first instance of immersion; because the subsequent swelling of the lime, breaks down the indurated mass; and, removing the hydraulic particles beyond the sphere of mutual action, prevents any useful effect from the remaining hydraulic power. The slaking the lime should, therefore, be complete before the cement is immersed. The best mode of slaking this lime has not been ascertained. Perhaps it would be best to sprinkle a little water on cement of this kind, leaving it for a few hours in the state of moist powder—perhaps leaving it exposed to spontaneous slaking for the requisite time—and perhaps throwing on a small quantity of water, in order to slake the lime, and then exposing the cement to heat for a short time, so as to drive off the water absorbed by the hydraulic constituents. This last mode is suggested by the following facts.

Some hydraulic cement A, which had been in a cask more than one year, on first opening the cask, hardened under water in three hours. After two or three days, it required five hours to harden; and after ten days, about nine hours—the cask being kept covered by the head lying loosely upon it. A little of this cement that had been out of the cask for more than a week, on being heated (but not to a red heat) for a few minutes, set under water in three hours. Some of the same cement that had been in the office, enclosed in paper, for about three weeks, required six hours to harden in water, while a little of it, after being kept on a red hot iron plate for about fifteen minutes, hardened in water in 45 minutes.

This power of restoring the energy of deteriorated cements may have many important applications.

Sand.

Several kinds of sand were used in the experiments, namely:

Sand No. 1.—This is the kind habitually used at Fort Adams in stone masonry. It is entirely free from dirt, and the particles, though not very sharp, are angular. Separated mechanically, it was found to consist, in 100 parts, in bulk, of

particles from	$\frac{1}{6}$ to $\frac{1}{12}$	of an inch in diameter—		about	10.00
do.	$\frac{1}{12}$ to $\frac{1}{24}$	do.	do.	do.	5.00
do.	$\frac{1}{24}$ to $\frac{1}{48}$	do.	do.	do.	48.00
do.	$\frac{1}{48}$ to dust			do.	45.00
do.	dust mostly silicious—no dirt			do.	4.50
100 parts in bulk producing				do.	112.50

Sand No. 2.—Is the above sand freed from particles larger than $\frac{1}{12}$ of an inch.

Sand No. 3.—Is the above sand freed from particles larger than $\frac{1}{48}$ of an inch.

Sand No. 4.—Is sand No. 2, pounded very fine after being freed from dust by washing.

Mortar Making.

With a view to a thorough incorporation of the constituents, at a small expense, and in order, at the same time, to break down the refractory particles of lime before mentioned, a mortar mill was constructed at the commencement of the works at Fort Adams in 1825, which has been in operation ever since.

The mill consists of a very heavy wheel about eight feet in diameter (having a tire one foot broad) moving in a circular trough fifteen inches wide at the bottom—the diameter of the circle being about twenty-one feet. The lime is slaked under the wheel, and ground until, with suitable additions of water, it has become a homogeneous paste sufficiently dilute to make mortar of the ordinary consistency. The requisite quantity of sand is then gradually sprinkled in, as the wheel is in motion. The draught is easy to the horse until near the last; when, for a few minutes, as he is giving the last turns, after all the sand has been thrown in, it is rather heavy. It was found convenient to use three barrels of lime to each batch of mortar.

The three mortar mills of Fort Adams were competent to supply in one

day 3077 cubic feet of mortar, at a total expense of $0.087 per cubic foot, viz.

105 casks of lime, at $1.52 per cask,	$159.60
2094 bushels of sand, at $0.04 per bushel,	83.76
Carting sand to mill, $0.12 for 20 bushels,	12.56
3 horses and 3 drivers, at $1.50 per day,	4.50
6 labourers, at $1.00 per day,	6.00
1 cooper at $1.00 per day,	1.00
Other small expenses say	0 58
Total cost of 3077 cubic feet of mortar	$268.00

or $0.087 per cubic foot. It appears that the expense of *making* the mortar was $12.08, being about ⅓ of a cent for a cubic foot.

The proportions in the above mortar are about 1 of lime in paste to 2½ of sand—should the proportion of lime be greater, the mortar will, of course, cost more.

The above statement refers to mortar made without addition of any hydraulic substance. But such mortars are now never used at Fort Adams. Hydraulic cement, or burnt clay, or brick dust, or some other similar matter is added to every kind of mortar made at the work, in proportions varying with the purpose to which the mortar is to be applied. The poorest mortar we make contains 1 barrel of hydraulic cement to 3 barrels of unslaked lime and about 15 barrels of sand; the cement being added before the sand, and while the lime is being reduced under the wheel.

All the mortars used in the experiments in the tables, were made by hand with the trowel, with such exceptions, only, as are noticed.

Trials of the Strength of Mortars.

The strength of mortars as regards tenacity, was determined by measuring the force required to separate bricks that, having been joined by the mortar, had been left, for the desired length of time, in some place safe from frost or accident.

The bricks were joined in pairs, being crossed at right angles thus,

so that, supposing each brick to be 4 inches wide, the surface of contact would be 16 square inches. The real surface, or surface of effectual contact, was, in every case, found by actual measurement. The mortar joint separating the bricks was made about $\frac{3}{8}$ of an inch thick: and, in order that this mortar should in all cases be equally consolidated, each pair of bricks was submitted to the pressure of 600 lbs. for 5 minutes, immediately after being joined.

An idea of the mode of separating the bricks may be got from fig. 9, Pl. II, where *a* and *b* represent two strong half-staples fastened to the floor: under these the ends of the lower brick are passed, while the ends of the upper brick are embraced by the piece of iron *c, c*, suspended from the steelyard *d*. The force needed to separate the bricks, is applied by pouring sand, at a uniform rate, into the bucket *e*. The weight of the sand and bucket, the mark on the beam where the weight was applied, and the weight of the *poise*, enable us to ascertain the force necessary to tear the bricks asunder. In the tables, the force required to separate the bricks is reduced to the proportional force required to tear up a surface of one square inch: so that if there were 16 square inches of actual contact, and the force used in separating the bricks was 1000 pounds, the table would represent the tenacity of the mortar by 62½ lbs.—equal to $\frac{1000}{16}$.

The hardness of the mortars was determined by ascertaining the weight, applied on a circular plane surface of 0.16 of an inch in diameter, (or .02008 of an inch area,) which the mortar would support. This mode of trial is represented in fig. 10, Pl. II. The circular surface at the extremity *a*, presses upon mortar still adhering to one of the bricks. The arms of the lever *b*, are of equal length, so that the upward force at *c* is equal to the pressure at *a*. The force is applied by means of a steelyard and sand, as in the preceding case.

The experiments were generally made with several pairs of bricks, and a mean was taken of the results; unless it had obviously been subjected to some accident or disturbance, being made to contribute to the mean. Very few results were rejected. There could be only as many trials of *tenacity*, in each particular experiment, as there were pairs of bricks. But for *hardness*, it was often possible to make a considerable number of distinct trials on the same surface of mortar: on the other hand, it would sometimes happen that the surface would be left too ragged and uneven for this trial: and in several instances this test seemed to be entirely inapplicable—the mortar beginning to yield with light weights, and continuing to yield more and more as the weight was increased, the whole effect being a gradual crumbling. In a great majority of cases, however, the effects were sufficiently decided to leave no doubt as to the moment when the power prevailed over the resistance—and sufficiently consistent to afford useful comparisons.

The method, just described, of trying the strength of mortars, was adopted in the Fort Adams experiments, on account of the facility of application. There was, in the first instance, no purpose of extending the experiments beyond what was deemed indispensable to a proper choice, and judicious application of materials, in the construction of a work of some magnitude, then being begun. One series of experiments, however, involved another and another, until the series became extended and the experiments too numerous and valuable, not to make it desirable that subsequent ones should be comparable with them, and, consequently, the same mode of test was continued.

It is probable that the method followed by Genl. Treussart, of making rectangular prisms of mortar, and subjecting them to fracture by weights suspended from the middle, is the best mode. It, at any rate, has the advantage of allowing mortars made in different places, and at distant times to be compared. This mode was adopted in some of the later trials at Fort Adams.

The following table exhibits the mean results of all the experiments made from 1825 to 1832; comprising seven series. The time of exposure of the 1st series was 5 months; of the 2nd. series, 10 months; of the 3rd, 10 months; of the 4th, 5 months; of the 5th, 10 months; of the 6th, 25 months; and of the 7th, 11 months. In :the 1st series, there were 2 pairs of bricks to each experiment; in the 2nd, 3 pairs; in the 3rd, 3 pairs; in the 4th, 1 pair; in the 5th, 4 pairs; in the 6th, 2 pairs; and in 7th, 3 pairs.

The first column prefixes a number to each kind of mortar, for convenient reference; the 2nd column expresses the nature, or composition of the mortar; the 3rd column, whether the bricks were *wet* or *dry* when joined together; the 4th, the number of series of which the results are a mean as to *tenacity*; the 5th, the *tenacity*, as expressed by the number of pounds required to tear open a joint of one inch square; the 6th, the number of series of which the results are a mean as to *hardness;* and the 7th, the number of pounds required to force into the mortar a circular plane surface of 0.16 of an inch in diameter.

Table No. LXV.

No.	Nature and Composition of the mortar.	Bricks wet or dry.	Tenacity. Number of series affording the mean.	Tenacity. Mean tenacity.	Hardness. Number of series affording the mean.	Hardness. Mean hardness.	Remarks.
1	New York Hydraulic cement B, alone	W	1	32.6			
2	do. do. do. A, alone	W	5	56.2	4	1053	
3	Roman cement (Parker's English) alone	W	1	18.5	1	260	
4	do. (do.) alone	D	1	22.6	1	412	
5	Lime alone	W	1	10.5	1	98	
6	Hydraulic cement A in powder 1; Sand No 3 .50	W	1	61.9	1	1055	
7	Cement A do. 1; Sand the same 1	W	6	40.3	5	993	
8	Cement A do. 1; Sand the same 1.50	W	5	33.1	4	918	
9	Cement A do. 1; Sand the same 1.50	D	2	30.4	1	765	
10	Hydraulic cement A in powder 1; Sand No. 3 2	W	3	17.5	3	670	
11	Cement A do 1; Sand the same 3	W	3	19.8	2	367	
12	Cement A do. 1; Lime slaked to powder .50; Sand the same 1.50	W	2	29.6	3	573	
13	Cement A do. 1; Lime the same .50; Sand No. 2 2	W	4	20.1	3	509	
14	Cement A do. 1; Lime the same 1; Sand No. 2. 2	W	4	28.3	3	778	
15	Cement A do. 1; Lime the same 2; Sand No. 2 4	W	4	17.1	3	545	
16	Cement A do. 1; Lime the same 2; Sand No. 2 6	W	4	16.2	3	267	
17	Cement A do. 1; Lime in paste, .50; Sand No. 2 1.50	W	1	44.4	1	765	
18	Cement A 1; Lime in paste .50; Sand No. 2 1.50	D	1	54.7	1	915	
19	Cement B do. 1; Sand No. 3 1	W	2	18.9			
20	Cement B do. 1; Sand No. 2 1.50	W	1	23.4			
21	Cement B do. 1; Sand No. 2. 2	W	2	14.7			

Table No. LXV—Continued.

No.	Nature and Composition of the mortar.	Bricks wet or dry.	Tenacity. Number of series affording the mean.	Tenacity. Mean tenacity.	Hardness. Number of series affording the mean	Hardness. Mean hardness.	Remarks.
22	Cement B do. 1; Lime in powder slaked .50; Sand No. 2 2	W	2	17.5			
23	Cement B do. 1; Lime the same 1; Sand No. 2 2	W	2	19.1			
24	Hydraulic cement B in powder 1; Lime slaked in powder 2; Sand No. 2 4	W	2	18.1			
25	Cement B 1; Lime the same 2; Sand No. 2 6	W	2	15.0			
26	Roman cement 1; Sand No. 2 .50	W	1	19.2	1	397	
27	Roman cement 1; Sand No. 2 1	W	1	16.8	1	309	
28	Roman cement 1; Sand No. 2 1.50	W	1	13.3	1	286	
29	Roman cement 1; Lime in paste 0.50; Sand No. 2 1.50	W	1	26.7	1	471	
30	Roman cement 1; Lime in paste 0.50; Sand No. 2 1.50	D	1	29.1	1	787	
31	Lime in powder 1; Sand No. 3 3.50	W	3	12.3	1	159	
32	Lime in powder 1; Sand No. 3 6	W	1	5.6	1	107	
33	Lime in paste 1; Sand No. 3 .50	W	1	14.3	1	208	
34	Lime in paste 1; Sand No. 3 1.50	W	3	15.4	2	275	
35	Lime in paste 1; Sand No. 3 3	W	4	12.8	2	146	Made with a hoe.
36	Lime in paste 1; Sand No. 3 2.50 *a* 3	W	6	14.3	3	202	Made in mortar mill.
37	Lime in paste 1; Sand No. 3 2.50 *a* 3	D	5	14.9	4	254	do. do.
38	Lime in paste 1; Sand No. 1 2.50 *a* 3	W	1	13.7	1	217	do. do.
39	Lime in paste 1; Sand No. 1 2.50 *a* 3	D	1	16.2	1	200	do. do.
40	Lime in paste 1; Sand No. 1 2	W	1	33.8	1	242	Lime different.
41	Lime in paste 1; Sand No. 1 2	D	1	26.6	1	231	

Observations on the Experiments of Table No. LXV.

1st. Generally, within the limits of the experiments, *a mortar made of lime and sand, or of hydraulic cement and sand, or of hydraulic cement, lime and sand—whether it was cement A, or cement B, or Roman cement, was the stronger, as the quantity of sand was the less.* In 24 comparisons, 3 exceptions.

In 13 comparisons of *tenacity*, 2 exceptions.

In 11 comparisons of *hardness*, 1 exception.

2nd. *It appears that with cement A, or cement B, any addition of sand weakens the mortar.* In all the cement experiments, except one, composed of Roman cement 1—sand $\frac{1}{2}$ (No. 26,) the cement alone, was stronger than when mixed with sand in any proportion whatever. Cement A (No. 6,) would seem to be another exception, but it is not; the strength of cement A, alone, as given in No. 2, is the average of five results with different specimens of cement, some of which were of inferior quality; while the result given in No. 6 is of one trial only, and that of a cement proving to be the best used; the particular result of No. 2 which corresponds with No. 6—that is to say, which was afforded by the same specimen of cement, gave for *tenacity* 74.7 lbs. and for *hardness* 1063 lbs., while No. 6 shows a *tenacity* of 61.9 lbs. and a hardness of 1055 lbs.

3rd. *It appears that when cement mortars are not required to be the strongest that can be made—a little lime may be added, without great loss of tenacity, and, of course, with a saving of expense.*

4th. *Mortar made in the mortar-mill was superior to mortar made by being mixed, in the common mode, with the hoe.*

5th. *When the bricks were dry and the mortar more fluid than usual, the mortar was better, both as to* TENACITY *and* HARDNESS*—in five cases out of seven, than when the bricks, being wet, were put together with mortar of common consistence.*

In the next table there is a comparison of the three kinds of lime—of the three modes of slaking, of various proportions of sand—of the effect of wet and of dry bricks on the mortar, &c.

In most cases six pairs of bricks were put together at the same time, and of the same materials; of which three pairs were separated after about 6 months, and the remainder after the lapse of 4 years and 5 months.

Table No. LXVI.

Showing the tenacity and hardness of mortars variously composed after exposure in the air.

No.	Nature and composition of the mortar.		Bricks wet. Tenacity per square inch. After 6 months.	Bricks wet. Tenacity per square inch. After 4 years and 5 months.	Bricks wet. Hardness. After 6 months.	Bricks wet. Hardness. After 4 years and 5 months.	Bricks dry. Tenacity per square inch. After 6 months.	Bricks dry. Tenacity per square inch. After 4 years and 5 months.	Bricks dry. Hardness. After 6 months	Bricks dry. Hardness. After 4 years and 5 months.	Remarks.
			lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
1	*Paste of Smithfield lime slaked by* DROWNING Sand No. 2	1 1	20.4	42.8	119	220					There are two kinds of Fort Adams lime in the table. The first, A, was imperfectly calcined: the second B, was thoroughly burned.
2	Lime the same Sand No. 2	1 2	15.2	18.8	130	297					
3	Lime the same Sand No. 2	1 3	12.6	16.6	182	232					
4	Lime the same Sand No. 2	1 4	13.2	16.4	85	203					
5	*Paste of Thomastown lime slaked by* DROWNING Sand No. 2	1 1	11.3	38.3	216	300		40.3		355	
6	Lime the same Sand No. 2	1 2	17.1	38.3	123	273		39.1		310	
7	*Paste of Thomastown lime, slaked by* DROWNING Sand No. 2	1 3	24.7	27.6	265	240		38.0		220	
8	Lime the same Sand No. 2	1 4	15.1	21.7	214	210		35.4		203	
9	*Paste of Fort Adams lime* A *slaked by* DROWNING Sand No. 2	1 1	13.4	21.9	105	273		34.0		186	
10	Lime the same Sand No. 2	1 2	9.9	18.8	68	175		22.5		110	
11	Lime the same Sand No. 2	1 3	12.6	22.7	75	93		22.8		187	
12	Lime the same Sand No. 2	1 4	9.6	11.5	92	93		21.4		102	
13	*Paste of Thomastown lime, slaked by* SPRINKLING Sand No. 2	1 1	26.8	49.1	259	798		40.6		787	
14	Lime the same Sand No. 2	1 2	26.4	35.6	225	666		57.3		370?	
15	Lime the same Sand No. 2	1 3	26.3	37.0	285	392		26.2		625	
16	Lime the same Sand No 2	1 4	25.2	31.0	289	313		38.0		347	
17	*Paste of Fort Adams lime* B *slaked by* SPRINKLING Sand No. 2	1 1	32.9	47.8	446	900		56.7		620	

Table No. LXVI. Continued.

No.	Nature and Composition of the mortar.	Bricks wet. Tenacity per square inch. After 6 months.	Bricks wet. Tenacity per square inch. After 4 years and 5 months.	Bricks wet. Hardness. After 6 months.	Bricks wet. Hardness. After 4 years and 5 months.	Bricks dry. Tenacity per square inch. After 6 months.	Bricks dry. Tenacity per square inch. After 4 years and 5 months.	Bricks dry. Hardness. After 6 months.	Bricks dry. Hardness. After 5 years and 5 months.	Remarks.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
18	Lime the same 1 Sand No. 2 2	33.1	54.5	228	600		52.4		507	
19	Lime the same 1 Sand No. 2 3	28.9	43.1	221	327		51.8		266	
20	Lime the same 1 Sand No. 2 4	23.5	30.4	254	258		52.6		233	
21	*Paste of Smithfield lime* AIR SLAKED 1 Sand No. 2 1		22.4		126					
22	Lime the same 1 Sand No. 2 2		9.9		85					
23	*Paste of Thomastown lime* AIR SLAKED 1 Sand No. 2 1				37?					
24	Lime the same 1 Sand No. 2 2		6.0		20?					
25	*Paste of Fort Adams lime* B AIR SLAKED 1 Sand No. 2 1		29.2		664					
26	Lime the same 1 Sand No. 2 2		21.6		281					
27	*Paste of Fort Adams lime B slaked by* DROWNING 1 Brick dust 0.40 Sand No. 2 1.40	16.3		104						
28	Lime the same 1 Dust of burnt clay .50 Sand No. 2 .50	17.5		168						
29	*Paste of Thomastown lime slaked by* SPRINKLING 1 Brick dust 2	35.0		360						
30	*Paste of Thomastown lime slaked by* DROWNING, measured before slaking 1 Sand No. 2 5	12.2	18.5	102	263		22.5		192	
31	Lime the same* 1 Cement A .33 Sand No. 2 5.50	15.4	23.1	165	192		42.6		230	*Equal, lime 1 Cement 0.33 Sand 5.00 do. 50 Lime 1 Cement 0.33 Sand 5.50
32	*Paste of Fort Adams lime B slaked by* DROWNING, measured before slaking 1 Sand No. 2 5	25.7	48.8	130	650		17.8		652	
33	Lime the same* 1 Cement A .33 Sand No. 2 5.50	22.7	46.7	194	849		46.2		303	
34	Cement A in powder 1 Sand No. 2 1.50	63.3	72.4		1508	467	88.4		1659	

Observations on the experiments of Table No. LXVI.

1st. *Within the limits of the experiments, whatever was the mode of slaking, or the kind of lime, the mortar was the stronger as the quantity of sand was less.*

The lime being measured in paste, the proportions were 1 of lime to 1 of sand; 1 of lime to 2 of sand; 1 to 3, and 1 to 4 of sand.

In all the corresponding trials of the table,

1 lime in paste, to 1 sand, gave the strongest mortar in 35 cases of tenacity, and in 13 cases of hardness.
1 lime in paste, to 2 sand, gave the strongest mortar in 3 cases of tenacity, and in 1 case of hardness.
1 lime in paste, to 3 sand, gave the strongest mortar in 2 cases of tenacity, and in 2 cases of hardness.
1 lime in paste, to 4 sand, gave the strongest mortar in 0 cases of tenacity, and in 1 case of hardness.

2d. *Slaking by* DROWNING, *or using a large quantity of water in the process of slaking, affords weaker mortar than slaking by* SPRINKLING.

In 24 corresponding cases of the table—The quantity and quality of the materials being alike: and there being no other difference than in the modes of slaking the lime.*

Lime slaked by SPRINKLING, gave the best mortar in 22 cases of tenacity, and in 24 cases of hardness.
Lime slaked by DROWNING, gave the best mortar in 2 cases of tenacity, and in 0 case of hardness.
The average strength in all the 24 cases in which the lime was slaked by *drowning* was, as to tenacity, 23.79 lbs., and as to hardness, 187.00 lbs.
While the average strength in all the 24 cases in which the lime was slaked by *sprinkling* was, as to tenacity, 38.63 lbs., and as to hardness 417.33 lbs.

The relative tenacity then is as 1 to 1.62; and the relative hardness as 1 to 2.23.

3d. *The experiments with air* SLAKED LIME, *were too few to be decisive—but the results were unfavourable to that mode of slaking.*

Average strength of the mortar made of *air-slaked* lime as to tenacity 20.80 lbs., and as to hardness 202.18 lbs.
Average strength of the corresponding mortars made of lime slaked by *drowning*, as to tenacity 27.10 lbs., and as to hardness 207.50 lbs.
Average strength of the corresponding mortars made of lime slaked by *sprinkling*, as to tenacity 46.70 lbs., and as to hardness 533.83 lbs.

4th. *The mortars were very materially stronger at the end of 4 years and 5 months, than at the end of the first half year.*

Of the 26 mortars which enter into this comparison, the average strength at the end of 6 months was, as to tenacity, 22.54 lbs., and as to hardness 166.33 lbs., and at the end of 4 years and 5 months it was, as to tenacity, 35.45 lbs., and as to hardness 367.37 lbs.
The relative tenacities being as 1 to 1.57, and hardness as 1 to 1.97 lbs.

5th. *Brick dust, or the dust of burnt clay, improves the quality of mortars both as to tenacity and hardness.*

6th. *Hydraulic cement added, even in small quantities, to mortars, improves their quality sensibly.*

* Except in their being two different burnings of Fort Adams lime

7th. ***The tenacity of mortars seems to have been increased by using dry bricks, and making the mortar a little more fluid than usual. But the hardness of the mortars was rather the greatest when* WET BRICKS *were used.***

In 21 corresponding instances, *wet bricks* and mortar of common consistency gave the best results, as to tenacity, in 5 instances; and, as to hardness, in 12 instances. *Dry brick* and mortar more fluid, gave the best results as to tenacity in 16 instances; and as to hardness, in 9 instances.

Table No. LXVII.

Trials in December, 1836, of mortars made in December, 1835. The results show the weights in pounds required to break prisms of mortar 2 inches square, 6 inches long and 4 inches in the clear between the supports.

				Lime from the same barrel.							Lime slaked with water enough to make a thin paste—and made into mortar after 12 hours.		Lime from the same barrel.			
No. of the comparison.	Sand No. 2.	Lime } slaked to powder with 1-3 of its bulk of water, measured in paste.	Cement A, cask No. 1, measured in paste.	Mortars made with the least possible quantity of water.	Mortars made rather thin.	Mortars made with equal parts of water and bitter-water.	Mortars made with bitter-water alone.	Mortars made of cement A, cask No. 2, which required much more time to set under water than cask No. 1.	Mortar made of calcined clay instead of cement A, cask No. 1.	Mortar made of sand No. 4, instead of sand No. 2.	Stone Lime.	Shell Lime	Lime slaked with ¼ its bulk of water, after being kept sealed hermetically in a jar 3 months.	Lime slaked to cream at first, and kept in that state in a keg under ground for 3 months.	Lime allowed to slake spontaneously for 3 months.	Lime slaked to powder with 1-3 its bulk of water and kept dry in a tight keg for 3 months.
1	1		½	497	370	323										
2	1		¾	562	502											
3	1		1	655	525	703	206									
4	1		1¼	782	516											
5	1		1½	707	721	1125	483									
6	1		1¾	783	712											
7	1		2	844	694	984	452									
8	1	1	¼		117			103	115	197						
9	1	⅓	⅓		351		220									
10	1	1	½		155			164	178	211						
11	1	1	¾		337			173	155	412						
12	1	½	1		469		295									
13	1	1	1		426			178	206	328						
14	1	1	1¼		328			305	187	469						
15	1	1	1½		295		295	267	206	426						
16	1	1	1¾		337			305	206	351						
17	1	1	2					548		511						
18	1	1	3		417		454	455								
19	1	1	4		389		455	520		806						
20	1	1	5		492		548	530		633						
21	1	1	6		576		553	649		862						
22	1	1									206	141	401	286	253	286
23	2	1									155	129	412	225	244	
24	3	1									122	173	356	160	159	244
25	4	1									131	89	286	169	150	220

Observations on Table No. LXVII.

It results from this table, and from the tables from which it has been abridged,

1st. *That in mortars of cement and sand (no lime) the strength is generally greater as the quantity of sand is less.* In 33 comparisons, 12 exceptions.

2nd. *That in mortars of sand, cement and lime—the lime remaining the same in quantity, the mortars were stronger as the quantity of sand was less in proportion to the cement.* In 57 comparisons, 10 exceptions.

3rd. *That in mortars of cement, sand and lime—the quantities of cement and sand being the same—the mortars were stronger as the quantities of lime were less.* In 52 comparisons, 15 exceptions.

4th. *That mortars made of cement and sand were materially stronger when the least possible quantity of water was used, than when the mortars were made thin.* In 14 cases, 1 exception.

5th. *That mortars made of cement and sand with the least possible quantity of water, were stronger when kept in a damp place, than when kept in a dry one.* In 7 comparisons, 1 exception. The experiments did not prove this to be true with reference to mortars made thin. These results were afforded by the experiments but are not included in the above table.

6th. *That in mixtures of lime and sand in various proportions, the mortar was generally stronger as the lime was slaked with less water.*

The average strength of several trials with 0.30 of water being represented by 80—with .40 of water, it was 98—with .60 of water, it was 72—with .80 of water, it was 60, and with 1.00 of water, it was 57. These results were afforded by the experiments, though not included in the table.

7th. *That mortars of lime and sand are materially improved by the addition of calcined clay, but not so much as by the addition of cement A.*

8th. *That sand freed from dust by washing and then pounded fine, gives much better mortars, than a sand composed of particles of every size from dust (no dirt) up to grains $\frac{1}{12}$ of an inch diameter.* In 21 comparisons, 2 exceptions.

9th. Many experiments were made to ascertain whether of two cements of the same manufactory, the difference being, probably, only difference of age, that cement which sets the quickest under water will give the strongest mortars in the air after a considerable lapse of time. The results leave the matter in doubt. The quick cement sometimes giving stronger mortars, and sometimes weaker.

10th. Of lime kept for three months after being slaked, before being made into mortar—the lime slaked into powder by sprinkling one-third of its bulk of water, gave the strongest mortar—represented by 250 lbs.; the lime slaked into cream gave the next strongest mortar—represented by 210 lbs., and the lime slake spontaneously during three months, the weakest mortar, represented by 202 lbs. All these mortars being much inferior to that made of the same lime which had been carefully preserved from slaking by being sealed hermetically in a jar—this last mortar being represented by 364 lbs. It must be remarked here that this result is very extraordinary for fat lime and sand; and it is probable this particular barrel of lime was somewhat hydraulic.

11th. Mortars of cement and sand in which bitter-water alone was mixed (Bitter-water being the mother water after the separation of muriate of soda from sea water,) were weaker than those in which water, or a mixture of equal parts of water and bitter-water, was used. But a mixture of equal parts of water and bitter-water gave much better mortar than water alone—the strongest composition we had, being cement $1\frac{1}{2}$, sand 1, and equal parts of water and bitter-water. In 8 comparisons, 2 exceptions.

The trials that afforded the two exceptions were with mortars containing a smaller proportion of cement than the six others. These facts seem to show that the addition of bitter-water, within certain limits, improves the cement, but that beyond these limits it is injurious; and that where the proportions of cement are great, an increased addition of bitter-water may be advantageous. These particular experiments were made in consequence of finding that the addition of a little bitter-water hastened the setting of cement A when immersed.

12th. *Mortars of cement and sand are injured by any addition of lime whatever, within the range of the experiments; that is to say from sand* 1, *lime* $\frac{1}{8}$, *and cement* $\frac{1}{8}$; *to sand* 1, *lime* 1, *and cement* 2. No exceptions in 67 comparisons.

13th. *Stone-lime, in the proportions tried, gives better mortar than shell-lime, as* 153 *to* 133: but some previous trials had afforded results slightly the best with shell-lime.

Table No. LXVIII.

Trials made in June, 1836, *of mortars made in September,* 1835.

The results show the weights, in pounds, required to separate each inch square of surface of bricks joined by mortars. The object is to compare grout with mortar.

No. 1.	Sand No. 2.	Lime slaked to powder and measured in paste.	Cement A.		Mortar.	Grout.
1	2	1		Lime and cement the same.	30.12	17.19
2	2	1	$\frac{1}{8}$		33.33	17.84
3	2	1	$\frac{1}{4}$		31.35	15.13
4	2	1	$\frac{1}{2}$		32.14	25.14
5	2	1	$\frac{3}{4}$		41.06	21.42
6	2	1	1		39.64	34.68
7	2	1		Lime and cement the same.	22.94	23.08
8	2	1	$\frac{1}{8}$		23.38	14.22
9	2	1	$\frac{1}{4}$		27.07	12.67
10	2	1	$\frac{1}{2}$		29.93	16.96
11	2	1	$\frac{3}{4}$		33.79	22.71
12	2	1	1		36.69	19.75

Observations on Table No. LXVIII.

In order to compare the strength of grout with that of mortar, bricks were joined (as before described) with the mortar given in the table—there being 4 pairs to each kind of mortar. To obtain similar joints of grout, bricks were supported on their ends and edges, in a box large enough to contain all, in such a way as to admit the proper quantity of grout to flow in between each pair. The box was not disturbed until the grout had become quite stiff, when it was first laid on one side, and then taken to pieces. The excess of grout was carefully cleared away from the bricks, which were removed without injury to any of the pairs, and put away by the side of the bricks joined with mortar.

It will be seen that, in every case but one, the grout was much inferior

to the mortar. The average strength of all the mortars in the table is 31.78, and the average strength of all the grouts is 20.06

Changes of bulk on slaking lime—making mortar, grout, &c.

A great many measurements were made of the changes of bulk in the operations of slaking, lime, making mortars &c., and the results, as might be expected, varied with the qualities of the lime. The following condensation of the results may be useful.

					trials.	varying from
1 lime and	¼ water	made, as a mean,	2.25	of powder.	27	1.56 to 2.97
1 do.	½ do.	do.	1.74	do.	4	1.55 to 1.83
1 do.	¾ do.	do.	1.81	do.	4	1.63 to 1.95
1 do.	1 do.	do.	2.06	do.	4	1.77 to 2.39
1 do.	2.54 do.	do.	2.68	of thin paste.	3	2.50 to 2.82
		Slaked by drowning.				
1 do.	1.70 do.	do.	1.98	do.	6	1.73 to 2.36
		Slaked by sprinkling.				

Lime in powder.	Water.				
1	0.40	made, as a mean,	0.66 thick paste.	2	0.65 to 0.67
1	0.50	do. do.	0.76 thinner paste.	19	0.67 to 0.94

1 lime air-slaked gave, as a mean, 1.84 powder 3 1.37 to 2.41

1 of air slaked lime in powder and 0.50 water made, as a mean, 0.75 thin paste, 2 trials varying from .70 to .80.

1 of lime (quick) pounded to powder, made 0.90 of powder, 1 trial.

1 of lime slaked to powder, kept dry for 3 months, still measured 1.00, 1 trial.

Sand.	thin paste.	cement.		mortar.	trials.	varying from.
1	52	00	made, as a mean,	1.17	13	1.06 to 1.21
1	58	0.125	do.	1.25	23	1.70 to 1.50
1	55	0.25	do.	1.37	3	1.29 to 1.54
1	61	0.35	do.	1.43	3	1.38 to 1.57
1	72	0.50	do.	1.60	2	1.50 to 1.70
1	1.00	0.125	do.	1.78	1	
1	1.00	0.25	do.	1.85	1	
1	1.00	0.50	do.	2.18	1	
1	1.10	0.75	do.	2.14	1	
1	1.40	0.25	do.	2.20	1	
1	1.28	1.00	do.	2.36	1	
1	1.00		do.	1·71	1	
1	2.00		do.	2.14	1	

1	50	00	do.	0.32	water,	made	1.27	grout.
1	50	0.062	do.	0.45	do.	do.	1.50	do.
1	50	0.125	do.	46	do.	do.	1.55	do.
1	50	.25	do.	51	do.	do.	1.66	do.
1	50	.375	do.	52	do.	do.	1.78	do.
1	50	.50	do.	61	do.	do.	1.88	do.

202	of mortar with	87	of water	made	290	of grout.
213	do.	87	do.	do.	305	do.
430	do.	180	do.	do.	604	do.
467	do.	201	do.	do.	660	do.
430	do.	180	do.	do.	620	do.

495 of mortar with	176 of water	made	664 of grout.
553 do.	180	do.	do. 711	do.

ARTICLE XXIV.—*Observations and experiments on Concrete, &c.*

It was ascertained, by careful measurement, that the void spaces, in 1 bulk of sand No. 1, taken from the middle of the heap, amounted to 0.33: the cementing paste, whatever it may be, should not be less therefore, than one-third the bulk of this sand. Taking one bulk of cement A, measured in powder from the cask, and a little compacted by striking the sides of the vessel, water was added till the consistence was proper for mortar: 0.35 of water was required to do this, and the bulk of the stiff cement paste was 0.625. To obtain, at this rate, an amount of cement paste equal to the voids (0.33) in the sand, will require, therefore, 0.528 cement in powder, and 0.185 of water, or

Dry sand,	1.000	making a bulk of 1.000 of mortar.
Cement in powder,	.528	
Water,	.185	

It is by no means certain that a mortar composed on this principle will be the most tenacious that can be made—on the contrary our experiments indicate that the mortar would be stronger with a smaller proportion of sand; but possessing the minimum quantity of cementing constituent, which is by far the most expensive ingredient, it affords the cheapest admissible mortar, made of cement and sand; and as it was probable, that it would shrink very little on drying, it was tried as a *pointing* for exposed joints, and also as *stucco*, and it answered very well for both purposes—becoming very hard, and never showing the slightest crack. An excess of cement, and a very *slight excess of water*, above the stated proportions, should be allowed for imperfect manipulation, because the proportions suppose every void to be accurately filled.

Extending the application of this principle to concrete—experiment showed that one bulk of stone fragments (nearly uniform in size, and weighing about 4 oz. each) contains 0.482 of void space. To convert this bulk of stones into concrete, we, in strictness, need use no more mortar than will fill this void space; and to compose this mortar we need use no more cement than is necessary to occupy, in the state of paste, the voids in 0.482 of sand. This concrete would therefore be composed as follows:

Stone fragments about 4 oz. each,	1.000	making a bulk of 1.000 of concrete.
Sand No. 1 . .	.482	
Cement in powder, .	.255	
Water, . .	.089	

Obtaining thus a cubic yard of concrete by the use of one-fourth of a cubic yard of cement in powder, (about one and a half bbls.)

But the above fragments were of nearly equal size, and of a form approaching the spherical: affording more void space than if they had been more angular, and had varied in size from about six oz. to less than one oz. such as would commonly be used. We have found that clean gravel, quite uniform in the size of the pebbles, which were about half an inch in average diameter, afforded voids to the amount of 0.39. And Mr. Mary, a French Engineer, used pebbles, probably mixed of coarse and fine, of which the voids were 0.37. The above allowance of 0.482 for void space is therefore quite large.

In all cases of the composition of concrete, the quantities expressed above, should be ascertained by actual measurement of the particular cement, sand and fragments, or pebbles, that are to be used. No better mode of measuring the void spaces, will be found, probably, than measuring the quantity of water that can be poured into a vessel already filled with stone fragments, pebbles, or sand, as the case may be.

Although the hydraulic property of cement will be the cause, in all cases of its use in concrete, it may happen that the cement at hand is more energetic than is actually necessary, and that the concrete would fully accomplish the object in view, even if it should be two or three weeks in becoming hard and impervious to water. Under such circumstances lime may take the place of part of the cement, with great economy. The lime may be added either in the state of powder that has been slaked some time, or in the state of paste: but in either case, the previous slaking must be complete.

The mortar is to be made first, and then the pebbles, or broken stones, may be mixed therewith by turning them over several times with the shovel.

When it is to be deposited under water, it is still a disputed point whether the concrete, prepared as above, should be used immediately, or be left in heaps to stiffen to such a degree as to require the use of pickaxes to break down the heaps: but, in works out of water, there can hardly be a case in which it will not be best to place it at once in its allotted space, where it should be compacted by ramming till none of the stone fragments project above the common surface. One or two trials will show how much mortar over and above the strict proportion is necessary in each case.

In circumstances where ramming cannot be applied, as when depositing concrete in deep water, the concrete should be more yielding and plastic —containing a larger proportion of mortar, and the mortar should be rammed before being deposited, in order thoroughly to imbed the larger constituents.

In many situations where concrete may be resorted to with great advantage, the economy need not stop at the above proportions. This substance may be rammed between, and upon, stones of considerable size—the only indispensable precaution being, to make sure that the stones are perfectly clean, are well imbeded in the concrete, and are far enough apart to permit the full action of the rammer between them.

The following case occurred at Fort Adams in October, 1836.

The proportions adopted were, *fragments of granite*, of nearly uniform size, and about 5 oz. each,	1.000	Bulk of concrete, a little more than 1.000.
Sand No. 1	0.500	
Cement A, in powder,	0.280	
Water rather more than	0.100	

Experiment gave 16.683 as the number of cubic feet of concrete made by 1 barrel of cement—187 barrels were consumed which afforded 115.52 cubic yards of concrete. There were also used, 11.29 struck Winchester bushels of sand, and 22.58 struck Winchester bushels of granite fragments.

187	barrels of cement at \$2.45	\$ 458.15
1129	struck bushels of sand at \$.0.37	41.77
2258	do. granite fragments at \$0.04	90.32
	Carried over,	\$ 590.24

Brought over,	$ 590.24

There were 151 days labour, applied to making mortar—making concrete—depositing the concrete in its proper place, ramming it into a compact mass, and doing all other work required in the operation.

151 days at $ 092.	138.92
Supervision	10.00
Cost of 115.52 cubic yards,	$ 739.16

Cost of one cubic yard $ 6.40

Springs of water flowed over this work continually; and were allowed to cover each day's work. The next morning the concrete was always found hard and perfectly set.

Had we dispensed with one half of the cement used, and used in lieu thereof, as much paste of lime, as the cement dispensed with would have furnished of paste of cement, the cost would have been materially reduced, and the work have been still very hydraulic, and very strong. In that case, the bulk would not have been altered, but would have been as before, 115.52 cubic yards. We should have used 93½ bbls. of cement less than we did: and, as cement, in passing to the state of paste, diminishes in bulk in the proportion of 1 to .625, we should have used 93.5×.625 equal to 58.43 barrels of paste of lime. Saving, thereby, the difference between the cost of 93.5 barrels of cement and 58.43 barrels of paste of lime.

93. 5 barrels of cement at $ 2.45	$ 229.07
58.43 do. of paste of lime at $ 0.60	36.06
Amount saved	$193.01

$ 739.16, less $ 193.01, equal $ 546.15; the cost of 115.52 cub. yards.
Cost of one cubic yard $ 4.73.

Another Instance.

Proportions—	Clean gravel,	1.000	Bulk of concrete about 1.15
	Sand No. 1,	.530	
	Cement A, in powder,	.430	
	Water about,	.140	

This was rammed into a mould of the capacity of 13.786 cubic feet.

Cement A,	4.35	struck bushels at	$ 0.59	cost $ 2.57
Sand No. 1, washed	5.44	do.	" 0.04	.22
Gravel	10.00	do.	" 0.04	.40
Cost of all the labour,				1.03
Total cost of 13.786 cubic feet,				$ 4.22

Being $ 0.306 per cubic foot, or $ 8.26 per cubic yard.

This became very hard, and is a very good substitute for stone, in certain applications.

Another Instance.

Proportions—	Clean gravel,	1.000
	Sand No. 1,	.625
	Cement A, in powder,	.333
	Water, about	.125

This was rammed into a mould of the capacity of 7.812 cubic feet; and the whole cost was $ 2.15, being $ 0.276 per cubic foot, or $ 7.45 per cubic yard.

This became a hard mass, but the concrete was rather too incoherent to make the best factitious stone.

Another case.

In this instance, a box containing 7.812 cubic feet was filled, first, with pieces of a stone of slaty structure—laying the pieces on their beds; a grout was then poured in, until all the interstices were filled. The composition of grout was as follows.

Washed sand No. 1,	1.000
Cement A in powder,	1.000
Water,	.910

The whole cost was $2.40—being $0.31 per cubic foot—or $8.37 per cubic yard.

This mass became hard, but was not so strong as those made of mortar instead of grout.

Numerous objects have, at different times, been moulded at Fort Adams, with analogous compositions, and always with success. Sometimes concrete was used, the entire mass being rammed into the mould: at other times the mortar without the fragments was used *as mortar*; bricks, or fragments of stones, being laid therein, in successive strata, until the mould was filled. Shafts of columns—the Doric echinus, abacus, &c., thus formed many years ago, resist the climate well, although less perfect than we should now be able to produce.

All our experiments concur in showing that much sand weakens cement mortar essentially; at least when exposed to the air. The improvement to be applied to the foregoing proportions should consist therefore, if the expense be no objection, in increasing the quantity of cement—taking care to keep the quantity of water as low as possible, in order to retain the shrinkage of the indurated mass at a minimum. It is surprising how much water may be driven out of an incoherent and apparently half-dry heap of cement-mortar, by hard ramming: and it is still more surprising, after the exact quantity necessary to saturation has been supplied, how small a quantity of water will suffice to convert a dry and powdery heap, if well worked, into a thin paste. Cements vary in their capacity for water: hence the dose of water is a matter that must be established by experiment in each case. The true quantity for concrete, and moulded objects in air, is that which, with hard ramming, affords a stiff paste, with a *little* free water on the surface: a state to which it can be brought with difficulty under the trowel or under the shovel. More water than this is attended with the double disadvantage of lessening the density of the mortar when dry, and of causing cracks by the shrinkage. If the quantity of water be thus regulated, the quantity of cement may be increased at pleasure, but the expense will increase rapidly with every addition of cement. In the first concrete above, the bulk of the dry cement is about one half the bulk of the sand, and the expense per cubic yard is $6.40; make the dry cement to equal the sand in bulk, and the expense per cubic yard will be about $10.00, all other proportions remaining, as they ought, the same.

In the preceding proportions it has been supposed that the concrete was to be used in the air, and that nothing would prevent the free use of the rammer. But if the concrete is to be deposited under water beyond the reach of this instrument, there should be a change of the proportions; and the quantity of mortar should be so increased that the fragments will be certain to be severally imbedded therein from their own weight, the gentle operation of the rake and other leveling instruments, and the pressure of the superincumbent concrete. Attention must be paid to the constituents

of the mortar, in reference to hydraulic energy, also, especially in running water: this mortar must not only be very hard after a time—it must become hard speedily; and to attain this end, the materials at command may demand proportions quite different from those required to fill the voids in the sand.

The following instances are derived from the practice of the French.

M. Mary, Engineer des Ponts et Chausseés, states that he ascertained the voids between the stones to be .37 of the whole bulk—that filling .90 parts of a box with stones, .10 parts+(.37×.90=.33)=.43 parts of mortar would be required, in theory, to fill the box: but he found that the box was more than full, showing that some of the mortar designed to occupy the voids did not reach them, from imperfect manipulation. Instead of .90 parts, he then filled .87 parts of the box with stones, which required that the mortar should amount to .13+ (.37×.87=.32) =.45 parts of mortar; and this he found filled the box very exactly. He also found that the transportation of the concrete, in wheelbarrows, from the mortar bed to the place where it was to be deposited, produced agitation enough to settle all the stones to their places, and bring the excess of mortar to the top. M. Mary is not aware that so large a proportion of stones had been employed any where else than at Pont-de-Remy, at Abbeville, and at the upper dam of Saint Valery; but at these places, no disadvantage resulted from the quantity, and the concrete was impervious to water. The mortar mixed with these stones was composed of 0.22 parts of feebly hydraulic lime measured in paste—0.225 of sand—and 0.225 of brick, or tile, dust ("*cement.*") The proportions of this concrete were therefore, as follows:

	Stones,	.87	Total bulk 1.000
	Sand,	.225	
	Brick, or tile dust,	.225	
	Feebly hydraulic lime in paste	.22	
	Water,		
Or—	Stones,	1.000	1.15
	Sand,	.259	
	Brick or tile dust,	.259	
	Feebly hydraulic lime in paste,	.253	
	Water,		

At the lock of Haningue the cube of concretes was composed as follows:

Pebbles,	.69	Bulk 1.00
Sand,	.40	
Hydraulic lime in paste,	.22	
Water,		

As to this case M. Mary observes that it is probable the pebbles were a mixture of coarse and fine gravel; because, with these quantities, in order to make up the cube of 1.00, the void spaces could amount to only about .09. This would be about 13 per cent. only of the measure of the pebbles, instead of 37, found by M. Mary, himself, in the case stated above. Expressing, as in the other cases, the proportions used at this lock, in parts of the measure of pebbles—it would stand thus,

Pebbles,	1.00	Bulk 1.45
Sand,	.58	
Hydraulic lime in paste,	.32	

To found the pier of the suspension bridge communicating between la Grève and l'ile de la Cité, at Paris, a concrete was used which was much more hydraulic than those just mentioned. It was thus composed:

Fragments of Buhrstone,	1.00	Resulting bulk 1.50
Sand,	.50	
Factitious puzzolana of M. St. Leger,	.25	
do. hydraulic lime do. (unslaked)	.25	
	2.00	

This concrete was placed in a bed eight feet thick, which, owing to a flood in the Seine, was about six weeks in being deposited. Masonry was begun upon it in eight days after its completion, and in six weeks it had the whole, pier to support; and before the concrete was four months and a half old it sustained the weight of the pier of the bridge, and of the proof load, without the least appearance of subsidence.

At the Saint Martin canal, where great quantities of concrete were used, the proportions were:

Pebbles,	1.00	Bulk 1.63
Sand,	1.00	
Hydraulic lime,	.33	

In another case, these proportions were used, viz:

Silicious pebbles,	1.00	Bulk 1.34
Tile dust and brick dust,	.28	
Fat lime made from chalk used at the moment of slaking—measured as quicklime,	.56	
Water, more or less,	.53	

Another case.

Rounded gravel about the size of a hazle-nut,	1.000	Bulk 1.15
Mortar, . .	0.500	

The mortar being composed of brick-dust,	1.00
Slaked lime, in powder,	1.00
Sea-sand,	1.00

After three months immersion in salt water, this concrete sustained a pressure on one end of the mass of 260,000 pounds per square foot of surface without impression. On being broken up, it showed that the gravel was well imbedded in mortar. The void space in the gravel was found to measure 0.35.

Another.

The aqueduct of Guétin, which conducts the Loire canal across the Allier, is composed of 18 arches of $53\frac{1}{2}$ feet span, and of 17 piers of 9.84 feet in thickness. Immediately at one end of the aqueduct are three connected locks, whereof the mass forms the left buttress of the bridge.

The right buttress and its wing-walls, the 17 piers, and the three connected locks, are built on a general "*radier*" or platform, 1594 feet long, 57.42 feet wide, and 5.41 feet thick; on the upper and lower sides of the platform are two guard walls 6.56 feet thick, and 14.76 feet deep—these walls, like the rest of the platform, rising to within 1.64 feet of the level of the water in the river in its lowest state.

The whole of the guard walls, as well as the lower layer of the platform,

for a thickness of 3.28 feet, were formed of concrete deposited in the water. The concrete used amounted to near 22,000 cubic yards.

The operation of depositing the concrete was confined to the 4 or 5 months between the spring and autumn floods; and at the end of the second season it supported the superstructure above described.

The following is the composition of the concrete:

Stone fragments,	1.000	
Mortar,	1.000	
The mortar was composed of sand,		1.50
Hydraulic lime measured in powder,		1.00
Artificial puzzolana of M. St. Leger,		0.50

And the puzzolana was formed by calcining, at a heat not great, a mixture of four parts of earthy clay measured in paste, and one part of fat lime measured in the same way—the mixed pastes being formed into small prisms, dried in the sun, calcined and pulverized.

In order to obtain some evidence of the actual strength of concrete, and to compare several varieties of composition, the experiments contained in the following table were made at Fort Adams: some prefatory remarks are necessary in relation to them.

The *cement* was obtained by taking several casks of hydraulic cement A, of nearly equal energy—emptying them into one heap on the floor, and, after mixing the contents intimately, returning the cement into the casks and heading them all tightly, until they were severally wanted. As the casks were opened, in succession, for use, the quality of the mixture was tried with the test wire, and was found to be very uniform—about half an hour being required for the setting. This cement had been on hand about four months.

The *lime* used was Fort Adams' improved lime. It was slaked to powder by the affusion of one-third its bulk of water, and allowed to stand several days. As it was about to be used, it was reduced to paste and passed through a hand paint-mill, by which it was made very fine. It should be borne in mind that this lime is slightly hydraulic.

The *sand* used was sand No. 1

The larger constituents of the concrete were of four kinds, viz: 1st. *granite fragments*, angular, average weight of each 4 oz.; 2d, *brick fragments*, angular, average weight 4 oz.; 3d. *stone-gravel*, made up of rounded pebbles from ½ to ¾ of an inch in diameter; and, 4th. *brick gravel*, composed of angular fragments of bricks from ½ to 1 inch in their greatest dimensions. All were perfectly free from dirt, and were drenched with water before mixing them with the mortar.

The measure of the void spaces in the granite and brick fragments was .48; and of the stone gravel and brick gravel, .39.

One set of experiments was made by using, in each case, a measure of mortar equal to the measure of void space—and another set, by using two such measures of mortar.

The mortar was made with as small a quantity of water as possible. On this account, the mixture of the constituents was probably somewhat imperfect; and to this may, in part, be attributed the irregularities observable in the results. The concrete, before ramming, was quite incoherent, especially when only one measure of mortar was used. It was, in every case,

consolidated by ramming into boxes that afforded rectangular prisms of concrete 12 inches by 6 inches by 6 inches.

The prisms were made in December 1836, and being kept in a damp place, safe from frost and accident, were broken in June, July, and August following. In breaking the prisms the two edges of the supports were 9 inches apart, leaving 1½ inch resting at each end: weights were applied, by adding about 60 lbs. at a time, to a scale-pan suspended from a knife edge which bore on the middle of the prism.

Table LXIX.

Trials made in June, July and August, 1837, of the strength of concretes made in December 1836. The results show the weight in pounds required to break prisms of concrete 12 inches by 6 inches by 6 inches—the distance between the supports being 9 inches.

No.	Composition of the Concrete.	Mortar No. 1. Cement A. 1.00, Sand No. 1., Lime	Mortar No. 2. Cement A. 1.00, Sand No. 1. .50, Lime	Mortar No. 3. Cement A. 1.00, Sand No. 1. .50, Lime .25	Mortar No. 4. Cement A. 1.00, Sand No. 1. 1.00, Lime	Mortar No. 5. Cement A. 1.00, Sand No. 1. 1.00, Lime .25	Mortar No. 6. Cement A. 1.00, Sand No. 1. 1.50, Lime	Mortar No. 7. Cement A. 1.00, Sand No. 1. 1.50, Lime .25	Mortar No. 8. Cement A. 1.00, Sand No. 1. 2.00, Lime	Mortar No. 9. Cement A. 1.00, Sand No. 1. 2.00, Lime .25
1	Granite fragments, with 1 measure of mortar	4973	4142	2778	3989	2721	2045	2056	lost	1574
2	do. with 2 do.	4068	4983	5064	4088	5366	1547	3537	1643	1972
3	Brick fragments, with 1 measure of mortar	3242	2117		4127	3254	1788	2136	1567	3649
4	do. with 2 do.	2805	5047	2826	4232	1178	3655	3856	2320	4803
5	Stone gravel, with 1 measure of mortar	1097	1049	1240	1256	1066				
6	do. with 2 do.	2347	4247	2655	1295	3351				
7	Brick gravel, with 1 measure of mortar	5437	6183	3088	lost	4726				
8	do. with 2 do.	6025	5712	5480	3142	2699				
9	Stone fragments, grouted	3278	1846	2012	1158	1178				
10	Brick fragments, grouted,	1634	2305	2869	2726	2770				

Observations on the experiments given in the above table.

It is to be regretted that such discrepancies are to be noted in the table. They are ascribable, in the first place, as suggested above, to the difficulty of bringing the mixture always to the same condition as regards the dissemination of the ingredients, when worked in so dry a state; but, probably, chiefly to the difficulty of filling the moulds always with equal accuracy, and ramming every part with equal force, when using so incoherent a mortar, united with so large a proportion of very coarse ingredients.

Notwithstanding these discrepancies, however, several deductions may be fairly drawn from the table, which, if confirmed by future trials, will be useful.

1st. *When the mortar was made of cement, sand, and lime, or of cement and sand without lime, the concrete was the stronger as the sand was less in quantity.* In 50 comparisons 19 exceptions. *But there may be* 0.50 *of sand and* 0.25 *of lime without sensible deterioration; and as much as* 1.00 *of sand and* 0.25 *of lime, without great loss of strength.*

2d. *A mortar of cement and sand does not seem to be improved by the addition of lime, while the bulk of sand is only equal to, or is less than, the bulk of cement; but as the quantity of sand is further increased, the mortar appears to be more and more benefitted by the addition of a small quantity of lime.*

3d. *Two measures of mortar, in concrete, are better than one measure; that is to say, a quantity of mortar equal to the bulk of the void space does not give as strong a concrete as twice that quantity of mortar.* In 30 comparisons, 7 exceptions. Nevertheless, the strongest example was with one measure of mortar, and it is not unlikely that the deficiency of strength in the other cases resulted from the difficulty of causing all the voids to be accurately filled, when the mortar was a minimum, and the space into which it was forced so small. It is not improbable that the voids may be perfectly occupied, even with one measure of mortar, when the mass of concrete is large enough to permit the full effect of the rammer.

4th. The results of the experiments recommend the several compositions of the table, in the following order, namely:

1.	Brick gravel,	with 2 measures of mortar,		No. 8.
2.	do.	with 1	do.	7.
3.	Brick fragments,	with 2	do.	4.
4.	Granite fragments,	with 2	do.	2.
5.	do.	with 1	do.	1.
6.	Brick fragments,	with 1	do.	3.
7.	Stone gravel,	with 2	do.	6.
8.	Brick fragments,	grouted		10.
9.	Stone fragments,	grouted		9.
10.	Stone gravel,	with 1 measure of mortar		5.

5th. *It appears that the best material to mix with mortar to form concrete, is quite small, angular, fragments of bricks: and that the worst is small, rounded, stone-gravel.*

6th. *Grout, poured amongst stone, or brick fragments, gave concretes inferior to all, but one, of those obtained from mortars.*

A piece of sound and strong *red sand-stone*, 12 inches by 4 inches by 4 inches, required a weight of 3673 pounds to break it—there being 9 inches between the supports. According to the formula $P=R.\frac{ab^2}{c}$,* prisms of

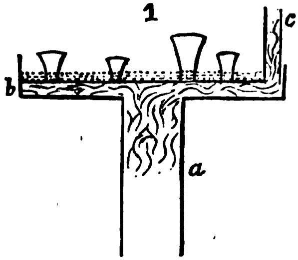
* In this formula P is the weight causing fracture, *c* the distance between the supports, *a* the breadth, and *b* the depth of the prisms.

this stone, of the size of our prisms of concrete, would require the weight of 12,396 lbs. to break them; whence it appears that the strongest concrete under trial, was, after eight months exposure, half as strong as this sandstone.

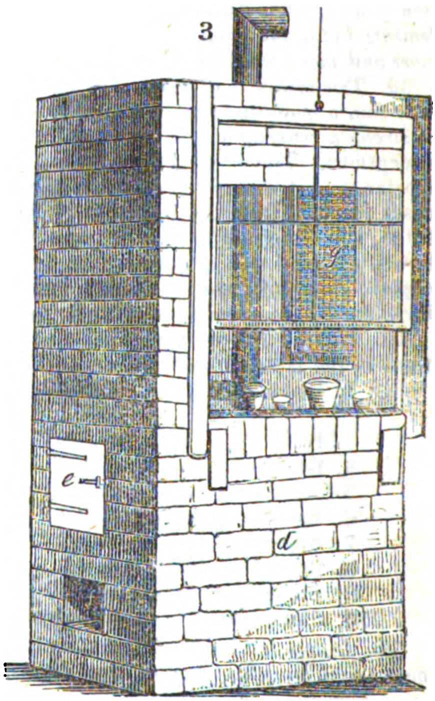
Description of a convenient mode of arranging a sand bath.

The practical chemist is always more or less incommoded by the corrosion of the balances and other delicate pieces of apparatus in his laboratory, by the gases and vapours evolved during the processes upon his sand bath. He is moreover subject to uncomfortable heat in the apartment from the necessity of keeping his bath at an elevated temperature. To obviate these inconveniences, I have devised an arrangement the description of which may be useful to those pursuing the subject. The accompanying figures represent the construction of one which I have now in use.

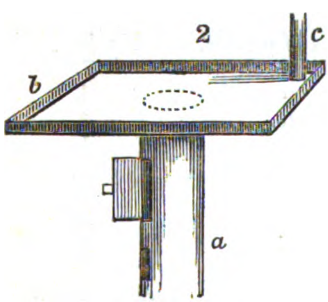
1



3



2



a, figs. 1, 2, represents a nine inch sheet-iron stove, without its ordinary top, while *b* shows a rectangular sheet-iron bath, two feet long by 18 inches wide, made to fit as a top upon the stove; the heated air from the stove is then made to circulate under the sand bath, before it can pass out through the pipe. *c*, fig. 3, represents the stove and sand bath, in place, surrounded by brick-work. *d*, is a chamber in which the stove is placed, and corresponding in size to that of the sand bath. The fuel is introduced into the stove through the hole *e*, and the ashes removed through *f*. The

chamber is made to communicate with the external atmosphere, by holes in the outer wall, against which the arrangement is built. The effect of the body of air circulating around the stove is to prevent entirely the wall of the chamber from becoming heated. *g*, represents a window in the wall of the building occupied by wire gauze, through which the vapours pass out, while their escape into the apartment is prevented by the movable sash, seen in front. Thus at the same time that the operator has completely under his eye and control all his process, he is entirely exempt from the inconveniences of the common forms of sand baths. R. E. Rogers, M. D.

Civil Engineering.

Fifth Annual Report to the Building Committee of the Girard College for Orphans; by Thomas U. Walter, Architect.

Gentlemen:—I have the honour, in conformity with your resolution of the 26th inst., to communicate the following report on the progress of the work during the past year.

The marble work of the centre building is raised to the height of the third story floor; all the arches over the second story are completed, and the quoins are commenced for the vaulting to support the roof;—nearly all the marble required to complete the cell of the building has been wrought;—two of the large antæ capitals are finished, and the workmen are now engaged in executing the other two;—three of the columns on the eastern flank have been raised to their destined height, two more are ready to receive their capitals, and two others are more than half finished;—one of these columns has been fluted and entirely completed, and the fluting of another is nearly finished; several of the large architraves have been delivered; also about 7000 cubic feet of marble for bases, capitals, and columns, beyond what has been used, nearly all of which will be wrought during the winter.

The carpenters are now about commencing the centres for the third story arches, all of which will be ready to set as soon as the spring opens.

The easternmost out building, which embraces the dwellings of the Professors, is nearly completed, and the building nearest the College is in such a state of forwardness as to admit of its being finished (if required,) in three or four months;—I am, however, of opinion, that neither of these buildings should be entirely completed until the time shall have been agreed upon for occupying them, as new buildings deteriorate much faster without occupants than with them;—it would, therefore, be better to keep them in such a state of forwardness that possession may be given at a few weeks notice.

The whole quantity of marble that has been delivered during the past year, amounts to 37,648 cubic feet;—31,974 superficial feet have been wrought and used in the building, and there are now on the ground about 13,500 feet of finished work, 1828 feet that have been sawed principally for ashlar, and 5564 cubic feet in the rough.

There have been 873,150 bricks delivered at the work during the last season, which, together with the 500,000 left on hand from the previous year, make 1,373,150, of which 1,211,150 have been used in the building, leaving 162,000 bricks now on the ground.

All the contracts have been faithfully executed, and every part of the work reflects the highest credit upon the superintendents of the various mechanical branches;—an unusual degree of skill and industry has been

evinced by the workmen, and the most perfect harmony has prevailed in all the departments of the work.

The delivery of marble during the past year has fully equalled our expectations, and there remains no doubt that the contractors will be able to continue the supply as rapidly as it will be required.

The expenditures, from December 31st, 1836, to December 30th, 1837, amount to $181,839 79.

There is now on the ground about $85,000 worth of materials and workmanship which have not yet been used in the building, and which includes capitals, bases, column blocks, and architraves for the portico, the marble for finishing the cell of the main building, and the steps and yard walls of the out-buildings, all of which will be available for the work of next season.

The building is now in a situation to admit of more work being done during the ensuing season than has been accomplished in any one year since its commencement;—the marble work of the cell being nearly completed, there will be nothing whatever to interfere with the progress of the brick work; all the arches of the third story may therefore be constructed, and the building prepared for the roof, before the close of the season,—the columns and architraves of the flank porticoes, and the steps and yard walls of the out buildings, may also be readily finished during the next year, as the whole attention of the stone-cutters will be directed to these objects:—about $285,000 will be required to accomplish this amount of work; it therefore only remains for you to say whether the buildings shall be advanced thus rapidly or not.

A temporary roof has been constructed over the whole of the main building, and the greatest precaution has been taken to prevent injury from frost;—conductors have been made to lead the water from the top of all the arches into sinks in the cellar, for the purpose of preventing the rains that fall on the work during the summer from percolating through the abutments and arches, and saturating the work in the lower stories.

Temporary furnaces for drying and warming the building during the winter have also been constructed, and the warm air introduced into every room in the house, notwithstanding the unfinished state of the work;—this arrangement was deemed expedient, not only to prevent injury to the arches from congelation and consequent expansion by cold, but also for the purpose of evaporating as much dampness from the walls as possible, previous to the occupancy of the building.

The expansible properties of *iron* having been a subject of considerable conjecture in reference to the bands for resisting the lateral pressure of the arches, I was induced to make an experiment for the purpose of discovering the actual difference of temperature produced in the middle of the walls, by the extreme heat of summer and the severest cold of winter.

Although I have never had an idea that any evil could possibly result from the expansion of the iron in question, by an increase of temperature, the materials which surround it being subject to an expansion almost (if not quite,) equal to that of the iron, yet the satisfaction to be derived from positive evidence on the subject is sufficient to give interest to the experiment;—I shall therefore give a brief account of the manner in which it was conducted, so as to enable you to judge how far the result may be relied on.

The place selected for the experiment was the brick wall between the south vestibule and the large rooms;—the thickness of this wall is five feet five inches, and its distance from the south front of the cell twenty-six feet; the sun had therefore full power upon it during the summer, and in the

winter the whole building was covered with a temporary roof:—I should also remark, that the experiment was completed before any fires were made in the furnaces.

On the 23d of September, 1836, the temperature on the work being at 82° Fahrenheit, a self-registering *minimum* thermometer was placed upon the iron band in the middle of the wall, and the work constructed as solidly around it as the rest of the building.

On the 29th of July, 1837, the temperature being again at 82°, a hole was made in the wall, and the thermometer taken out, when it was found that the register had descended to 42° during the intermediate winter, the extreme cold of which was 3° below zero:—thus we find the greatest cold in the middle of the walls to be 42°.

On the 16th of January, 1837, the temperature on the building being 24° Fahrenheit, a self-registering *maximum* thermometer was placed on the iron band in the middle of the aforementioned wall, on the same horizontal line with the other thermometer, and about sixty feet distant from it, a space having been left in the wall when it was built, for the purpose; which space was walled up around the thermometer as firm and compact as the rest of the work.

On the 16th inst., the temperature on the building being again at 24°, the walling was taken out, when it was found that the register in the thermometer had gone up to 61° during the intermediate summer, the greatest heat of which was 94°.

We have therefore 42° for the lowest temperature of the iron bars, and 61° for the highest, making a difference of 19°.

The expansion that an increase of temperature of 180° produces upon malleable iron, is given by Dr. Ure, in his Dictionary of Chemistry,* as follows:

From experiments by Smeaton $\frac{1}{784}$ of its length; according to Borda's experiments $\frac{1}{865}$ of its length; and according to Dulong and Petit $\frac{1}{846}$ of its length.

Mr. Hassler, (of New Jersey,) in his "Account of Pyrometric Experiments," read before the American Philosophical Society, June 29th, 1817,† finds the expansion to be equal to $\frac{1}{798}$ of its length; and in a work on Natural Philosophy, by Biot,‡ we have the experiments of Lavoisier and Laplace, made in 1782, giving an expansion, under the same increase of temperature, equal to $\frac{1}{819}$ of its length.

The trifling difference in these results may be attributed to a difference in the density of the material.

Now, if 180° will increase a bar $\frac{1}{784}$ of its length, (this being the greatest expansion obtained by the foregoing experiments,) 19° will lengthen it only $\frac{1}{7526}$; hence the bands around the rooms of the College, (each being 54 feet long from the points of support,) will be subjected to a difference in their length between the extreme heat of summer and the severest cold of winter, of $\frac{1}{7526}$ or $\frac{1}{12}$ of an inch.

This being the actual difference produced in the length of the iron bands, by the greatest change of temperature to which they can be subjected, it remains for us to consider the expansibility of the materials with which they are surrounded.

A table on the expansion of different kinds of stone, &c., from an increase

* Ure's Dictionary of Chemistry, page 272.

†Transactions of the American Philosophical Society—new series—Vol. I., page 227.

‡ Physique de Biot, Vol. I.

of temperature, is given by Mr. Alexander J. Adie, civil engineer, in a paper read before the Royal Society of Edinburgh, on the 20th of April, 1835,* in which he makes the expansion produced upon bricks by 180° of Fahrenheit, equal to $\frac{1}{1818}$ of its length, or $\frac{1}{26}$ of an inch in 54 feet under an increase of temperature of 19°.

If, therefore, the maximum expansion of one of the iron bands in the walls of the College is $\frac{1}{12}$ of an inch, and the brick work surrounding it $\frac{1}{26}$, the difference is then reduced to nearly $\frac{1}{22}$ of an inch:—but if we consider that the variation of temperature in the interior of the wall is only 19°, while the exterior is subjected to the extremes of heat and cold, it will be obvious that the aggregate expansion and contraction of the brick work is even greater than that of the iron.

From these considerations, it is evident that not the slightest injury can possibly result from the use of iron in the construction of the College.

I am, gentlemen, very respectfully, your obedient servant,

Thomas U. Walter, Architect.

Girard College, December 30th, 1837.

To James Hutchinson, Esq.
Chairman of Building Committee, Girard College for Orphans.

Physical Science.

For the Journal of the Franklin Institute.

Report of some Meteorological Observations made at Frankford Arsenal, near Philadelphia. By Captain A. Mordecai, of the Ordnance Department.

1. *Of the Temperature.*

In a former paper on this subject [Journal of Franklin Institute, Vol. XIX. p. 7] I gave the results of hourly observations of the thermometer during one year, from which were deduced the hours of daily mean temperature, and of daily maxima and minima in each month, and it was also shown that the mean temperature derived from the daily extremes is the same as that derived from hourly observations. As the temperature changes very slowly near the maximum and minimum points, the observation of the extremes of daily temperature is little subject to error, and we have thus a method of testing the accuracy of the deductions previously made, as to the hours of observation for the mean temperature of the day. For this purpose I have made, during two years, four daily observations of the thermometer; two for the maxima and minima, and two for the means. The hours selected for the observations, and the results for each of the years ending 30th April, with the average for the two years, are presented in the following table.

*See Journal of the Franklin Institute of the State of Pennsylvania, Vol. XX. page 200.

Table of Mean Temperature.

	Hours of Observation. For the Means A. M.	Hours of Observation. For the Means P. M.	For the Extremes A. M.	For the Extremes P. M.	1836, '37. Mean temperature deduced from daily means.	1836, '37. daily extremes.	1836, '37. 4 daily observations.	1837, '38. Mean temperature deduced from daily means.	1837, '38. daily extremes.	1837, '38. 4 daily observations.	Two Years. Mean temperature deduced from daily means.	Two Years. daily extremes.	Two Years. 4 daily observations.
	H. M.	H. M.	H.	H. M.									
May, . .	8.30	7.45	4.	2.30	62.05	61.51	61.78	59.82	59.53	59.82	60.94	60.52	60.80
June, . . .	8.	8.	4.	2.30	64.03	64.61	64.32	67.75	67.68	67.01	65.89	66.12	65.76
July, . .	8.	8.	4.	2.30	72.83	73.49	73.20	71.60	72.41	72.01	72.22	72.95	72.61
August, . .	8.	8.	4.	2.30	76.60	68.32	67.95	70.34	71.08	70.90	68.97	69.66	69.43
September,	8.30	7.30	5.	2.30	65.94	67.38	66.87	61.97	62.50	62.27	63.96	64.94	64.57
October, .	9.	7.	6.	2.30	48.44	48.36	48.58	54.17	54.36	54.54	51.32	51.36	51.56
November,	9.	7.	6.	2.30	40.33	40.78	40.82	45.31	45.85	45.62	42.82	43.32	43.22
December,	9.	7.30	6.	2.30	32.35	32.47	32.62	35.45	35.30	35.39	33.90	33.89	34.00
January, .	9.	7.30	6.	2.30	27.81	27.40	27.68	36.29	36 80	36.63	32.05	32.10	32.15
February, .	9.	8.	6.	2.30	31.74	31.86	32.21	24.35	24.58	24.59	28.05	28.22	28.40
March, .	9.	8.	5.	2.30	38.57	38.80	38.87	40.37	40.72	40.58	39.47	39.76	39.73
April, . .	9.	8.	5.	2.30	47.92	47.98	48.06	46.00	46.16	46.13	46.96	47.07	47.09
12 months.					49.97	50.24	50.25	51.11	51.41	51.29	50.54	50.83	50.77

This table shows the mean temperature deduced, 1st, from two daily observations at the hours stated in the first and second columns; 2nd, from two observations at the hours stated in the third and fourth columns; 3rd, from the four daily observations combined. These results, agreeing very nearly with each other, show that the hours chosen for the observations of the mean temperature are nearly correct; but in comparing the results of the morning observations for the mean with those of the evening, (results which it is not thought necessary to show separately in the table,) I find that the former give generally (and especially in the summer season,) too low an average, and the latter a little too high; the excess in the one case not compensating for the defect in the other; as the general average is seen to be somewhat too low, when compared with the general mean of the ex-

tremes. A closer approximation to the true times of mean daily temperature could hardly have been expected, from a register of only one year's observations, but by the aid of the above table we may correct the previous deductions, and we shall probably find the true times for observing the mean daily temperature to be nearly as follows, viz:

	h	h
For February, March, April, and May,	9. A. M.	8. P. M.
June, July, and August, . .	8.30	8.
September, October, November, Dec. and Jan.	9.00	7.30

I subjoin a statement of some general results of the three years observations.

	o
Mean temperature of the year ending April 30th, 1836	49.21
Maximum observed July 13th, 3 and 4 P. M. .	89.50
Minimum observed February 6th, 5 and 6 A. M. .	-7.00
Extreme range of temperature . . .	96.50
Mean temperature of year ending April 30th, 1837, .	50.24
Maximum observed July 9th, 2½ P. M. . .	89.00
Minimum observed January 3d, 6 A. M. . .	6.00
Extreme range of temperature . . .	83.00
Mean temperature of year ending April 30th, 1838. .	50.77
Maximum observed August 30th, 2½ P. M. .	89.00
Minimum observed February 21st, 6 A. M. . .	10.00
Extreme range of temperature . . .	79.00
Average of three years.	
Mean temperature, ...	50.07
" Maximum, ...	89.17
" Minimum, ...	3.00
" Yearly range, ...	86.17

2. *Of the Rain.*

At the same time with the thermometric register, I began a series of observations with a view to furnish data for discussing the question of the relative quantities of rain received on equal surfaces at different heights above the ground. For this purpose two stations were chosen; one on the ground, in an open garden; the other on the top of a tower attached to the principal store house at the Arsenal, and about 250 feet in a south-easterly direction from the first. The tower is about twenty five feet square; it has a flat roof surrounded by an open balustrade about three and a half feet high, and the roof is nearly on a level with the ridge of the building to which the tower belongs; the tower is on the west side of the building, the ridge of which runs north and south. The prevalent winds are N.E. and N.W. The roof of the tower is fifty-two feet above the ground at the first station, which latter is about twenty-three feet above low water in the Delaware. The surrounding country is open and nearly level for more than 100 miles towards the north and west, and on the south and east no high lands intercept the winds from the Atlantic. The same kind of rain gauge was used at each station: it consists of a cone of tin to the base of which is attached a short cylindrical rim 5 inches in diameter, the water received in which passes through an opening of $\frac{3}{16}$ of an inch at the apex of the cone, into a cylindrical receiver to the neck of which the conical part is closely fitted by a collar; the whole is painted white and enclosed in a wooden box likewise painted white.

The water thus collected is measured in a glass tube graduated so as to allow of reading less than $\frac{1}{100}$ of an inch of rain. The measurements were

punctually made immediately after each rain, but the evaporations from these gauges is so slight that no appreciable error would have arisen from permitting the water to stand in them many days.

To test this experimentally the two gauges were placed side by side during the month of July, 1837; it rained eight times during the month, and half of the whole quantity of rain fell before the eighth day: one of the gauges, measured after each rain, gave a total of 3in.677; the other at the end of the month gave 3in.680.

To measure the snow, which would fill the conical part of the gauge without finding its way into the receiver, I used two other gauges of the same diameter as the first at the top, but widening downwards and terminating in a receiver of sufficient capacity to contain all the snow that could enter it during one storm. These gauges, whilst in place, were measured for the rain as well as the snow, and although the individual results did not always correspond, the total for each month generally confirmed that obtained from the rain gauges.

In consequence of the drifting of the snow it may be thought that the quantity received in an open vessel cannot afford an accurate measure of that which falls; but the general agreement in the results obtained from the two gauges at each station, in the frequent cases where the snow in both could be measured, leads me to think that the error from this cause is not great.

Under the head of temperature in the following table, are shown the mean temperature of each period, and the average daily range of temperature, or mean of the daily maxima and minima, derived from the observations referred to in the preceding part of this paper. The column of "ratios" shows the proportion of the quantity of rain received on the tower to that received on the ground, the latter quantity being represented by 1000. The height of the tower is not sufficient to admit of an intermediate place of observation between it and the ground, and there is no higher point attainable at the arsenal: having then but one station above the ground, these results do not, in themselves, afford the means of discussing the laws of diminution of rain at various heights, but they may be useful for that purpose in conjunction with other observations of a similar kind which may have been made at Philadelphia, or its vicinity. Some such were made by Prof. A. D. Bache, on the top of a shot tower, in Philadelphia—I proceed to state such remarks as are suggested by an examination of table I.

1. Additional evidence is afforded to the now established fact of a diminution in the quantity of rain at different heights above the ground. A remarkable deviation, however, from this law is seen in the results of the winter observations in 1835–'36, where in the months of November, December, January and February, the greatest quantity of rain was received at the *upper* station; that winter was very cold, (the thermometer marking at one time 7° below zero,) and there fell a great quantity of snow, the measurement of which is, as before observed, included in the general statement; but the anomaly cannot be attributed to the accidental *drifting* of the snow, since it is equally marked in cases where little or no snow fell, and besides it would be much more apt to drift into the lower gauge than the upper. In the two succeeding winters, which were milder, with less snow, this anomaly is not observed, the diminution in the second winter being greater in the cold months than in the warm.

TABLE No. I—*Results for three years.*

	1835–'36.			1836–'37.			1837–'38.			Average of three years.				
	Mean. Temperature.	Rain.		Mean Temperature	Rain.		Mean Temperature.	Rain.		Temperature.		Rain.		
		Ground.	Tower.		Ground.	Tower.		Ground.	Tower.	Mean.	Mean range.	Ground.	Tower.	Ratio to 1000.
		in.			in.			in.				in.	in.	
May,	59.18	2.196	2.050	61.83	1.929	1.695	59.82	4.351	4.001	60.28	19.35	2.825	2.582	914
June,	67.78	4.231	3.936	64.33	7.665	7.137	67.01	2.814	2.737	66.37	14.06	4.908	4.603	939
July,	71.58	6.159	5.861	73.20	1.917	1.835	72.01	3.677	3.356	72.26	14.03	3.918	3.684	930
August,	68.46	2.494	2.289	67.95	2.356	2.297	70.90	4.579	4.250	69.10	13.87	3.143	2.935	934
September,	59.43	2.900	2.723	66.87	1.906	1.814	62.27	2.228	2.126	62.86	14.10	2.344	2.221	948
October,	56.20	1.169	1.051	48.58	2.929	2.649	54.54	0.569	0.524	53.11	16.02	1.555	1.408	906
November,	44.98	2.862	2.906	40.82	2.921	2.792	45.62	2.386	2.248	43.81	13.06	2.723	2.648	972
December,	29.90	2.799	2.987	32.62	3.850	3.385	35.39	2.367	2.289	32.64	12.42	3.005	2.887	962
January,	27.68	5.138	5.407	27.68	1.745	1.598	36.63	1.721	1.600	30.66	11.96	2.867	2.869	1000
February,	23.07	2.498	2.662	32.21	2.809	2.651	24.59	1.549	1.468	26.62	12.85	2.289	2.260	987
March,	33.58	1.420	1.390	38.87	3.425	3.332	40.58	2.242	2.173	37.68	15.68	2.362	2.298	973
April,	48.65	3.019	2.943	48.06	1.969	1.850	46.13	2.841	2.739	47.61	16.16	2.610	2.510	962
Spring,	47.14	6.635	6.383	49.59	7.323	6.877	48.84	9.434	8.913	48.52	17.06	7.797	7.390	948
Summer,	69.40	12.884	12.086	68.49	11.938	11.239	69.97	11.070	10.343	69.24	13.99	11.964	11.222	938
Autumn,	53.54	6.931	6.680	52.09	7.756	7.255	54.14	5.183	4.898	53.26	14.39	6.622	6.277	948
Winter,	26.88	10.435	11.056	30.84	8.404	7.634	32.20	5.637	5.357	29.97	12.41	8.161	8.016	982
6 warm months,	63.77	19.149	17.910	63.79	18.702	17.397	64.43	18.218	16.994	64.00	15.24	18.688	17.433	933
6 cold months,	34.64	17.736	18.295	36.71	16.719	15.608	38.16	13.106	12.517	36.50	13.69	15.856	15.472	976
12 months,	49.21	36.885	36.205	80.25	35.421	33.005	51.30	31.324	29.511	50.25	14.46	34.544	32.905	953

The only notice which I have seen of such an excess of rain at the upper station is in the Journal of the Franklin Institute, vol. XVII, p. 286, where it is recorded that at Kinfaun's Castle, a greater quantity of rain

was received, in 1834, in a gauge elevated 160 feet above the ground, than in one on the ground; the difference in this case was very small, (only $\frac{14}{100}$ of an inch,) but the observation is not the less remarkable, for at such an elevation a difference of at least one third in favor of the lower gauge might be expected.

2. The average quantity of rain received on the ground is 32½ inches in a year; the average quantity fallen in the six warm months has been greater than in the six cold months. The quantities fallen in Spring and Autumn, have been nearly equal, but the average in summer has exceeded that in Winter by nearly *one fourth*. Here it should be remarked, however, that this great disproportion is occasioned chiefly by the unusually great quantity of rain, (nearly nine inches,) which fell between the 28th of May and the 30th of June, 1836.

3. The average diminution of quantity at the height of 52 feet is about 5 per cent; and this result of the three years observations agrees very nearly with that which is obtained from an average of the rain that has fallen without wind or with very light winds, when the observations may be considered least liable to error.

4. The diminution at the upper station is, in the three years, and in the general average, greater in Summer than in Winter. This result also is inconsistent with those of previous observations. In the reports of the British Association for the advancement of Science, (third and fifth meetings,) the present subject is discussed mathematically by Prof. Philips, from the results of three years observations at York, from which he has deduced formulæ to represent the relation which the diminution of rain bears to the height of the station and to the temperature of the season; but as his observations gave the diminution greatest in the cold season, he makes the *amount* of diminution dependant on the temperature of the season *inversely*, whilst here it appears to vary with the temperature *directly*.

5. The column of mean daily range of temperature in the table, is given as a substitute for the observation of the mean dew point in ascertaining the relative dryness of the air at different seasons; the dryness being considered directly proportional to the mean range of temperature. Here again, if my observations are correct, the law of diminution is different from that which obtains at York; for the diminution of rain as we ascend seems here to be greatest in the dryest season, or when the mean range of temperature is greatest; whereas at York it bears an *inverse* relation to the mean range. The latter relation seems the more probable, and accords with the natural solution of the question, which attributes the increase of the quantity of rain in descending to an augmentation of the drops in passing through a warm and more moist tract of air: I am, therefore, inclined to doubt whether some disturbing cause, that may impair the correctness of the observations, may not have escaped my notice. But the laws of variation in the quantity of rain may be, and probably are, very different in our climate from those which hold good in England, and my observations having been carefully made, will serve, I hope, to throw some light on the subject.

In order to ascertain whether such a disturbing cause as I have referred to could be found in the direction of the wind, at the time of the rain, I have arranged the results of the observations with reference to the course of the wind as in the following table.

TABLE II—*Average quantity of rain from each quarter.*

1835 to 1838.	RAIN. N. E.		S. E.		S. W.		N. W.		TOTAL.	
	Ground.	Tower.	Ground.	Tower.	Ground.	Tower.	Ground.	Tower.	Ground.	Tower.
May,	2.153	1.978	0.153	0.146	0.400	0.372	0.116	0.086	2 825	2.582
June,	2.315	2.153	0.916	0.914	1.222	1.162	0.447	0.384	4.903	4.603
July,	2.931	2.766	0.166	0.162	0.572	0.521	0.248	0.235	3.918	3.684
August,	1.492	1.423	0.219	0.196	0.628	0.596	0.804	0.720	3.143	2.935
September,	1.515	1.444	0.515	0.487	0.273	0.251	0.041	0 039	2.344	2.221
October,	0.749	0.678	0.211	0.197	0.534	0.479	0.061	0.054	1.555	1.408
November,	1.670	1.695	0.286	0.237	0.571	0.529	0.196	0.187	2.723	2.648
December,	0.940	0.913	0.658	0.612	0.631	0.521	0·776	0.841	3.005	2.887
January,	2.290	2.318	0.	0.	0.348	0.322	0.229	0.229	2.867	2.869
February,	1.916	1.928	0.134	0.111	0.235	0.219	0.004	0.002	2.289	2.260
March,	1.955	1.910	0.253	0.250	0.154	0.138	0.	0.	2.362	2.298
April,	1.507	1.451	0.	0.	0.757	0.729	0.346	0.330	2.610	2.510
Six warm months,	11.158	10.442	2.180	2.099	2.626	3.381	1.717	1.518	18.688	17.433
Ratios,	1000	936	1000	961	1000	932	1000	884	1000	933
Six cold months,	10.278	10.215	1.331	1-210	2 696	2.458	1.551	1.589	15.856	15.472
Ratios,	1000	994	1000	909	1000	912	1600	1.024	1000	976
Twelve months,	21.436	20.657	3.511	3.312	.6325	5.839	3.298	3.107	34.544	32.905
Ratios	1000	963	1000	943	1000	923	1009	942	1000	953

From this table it would appear that the ratio of the quantities of rain at different heights is not much influenced by the mere *direction* of the wind, for the ratios of the quantities received from the same direction in different seasons do not correspond. The relative ratios in different seasons, from different directions appear anomalous, but it is to be remarked that the quantity of rain received at one time from other than the N. E. direction is, generally speaking, so small that the error of measurement, or of accidental variation, is more sensible.

In comparing the individual observations, I observe that the *force* of the wind exercises a decided influence on the ratio of the quantities of rain;

the diminution in the upper gauge being generally greater in proportion to the violence of the wind; in one instance, of a violent storm from the S. W. the diminution was as great as 36 per cent. This effect must be attributed chiefly to eddies from the roof of the building, preventing the rain from entering the gauge, and from this cause it is probable that we shall arrive at a correct mathematical solution of our question only by taking account of the rain which falls in calm weather, or accompanied by very light winds. At the same time I must remark that in analysing the second and third years' observations, omitting those in which the rain was accompanied with high winds, I do not find that the results differ materially from those given by the general average for those years.

Table II is interesting as exhibiting the average quantity of rain which has reached us in each of the last three years, from different quarters. Thus we see that *two thirds* of the whole quantity has come from the N. E., about *one-sixth* from the S. W., and *one-twelfth* from each of the other quarters. The numbers in the table are the results of 260 observations, being for each of the three years an average of 87, viz:

From N. E.	43	observations,
S. E.	7	"
S. W.	24	
N. W.	13	"
Mean total	87	"

The average number of days in each year on which rain or snow fell is 117.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN SEPTEMBER, 1837.
With Remarks and Exemplifications by the Editor.

267. For an improvement in the mode of *Working Pumps for Pumping Ships, &c.;* David Gay, Bath, Lincoln county, Maine, September 8.

The pumping is to be effected by the rolling of the vessel, and to effect this there is to be a vertical shaft of iron, having a step, and a bearing in a suitable frame. Towards the upper end of this shaft there is to be a cast iron weight, sustained by means of arms, which weight is to cause the shaft to revolve. Near the lower part of the shaft is a horizontal wheel, firmly attached, and sustaining seven, or any other suitable number of, friction wheels, which may be one foot each in diameter; they are to revolve on centre pins passing through the face of the horizontal wheel, near its periphery, and, of course, projecting nearly one half their diameters beyond said wheel. As the shaft revolves, or vibrates, these friction wheels are to work three pump brakes, with projecting arms from which they are to be kept in contact, by means described in the specification. As the vessel will not be always rolling, a hand lever is attached to the apparatus, to work the pumps when necessary. The claim is to "the application of the weight to the shaft of the eccentric wheel for giving motion and action to the pistons of the pump, by the rolling or pitching of the ship, or vessel, at sea, or in rough water; and combining therewith a hand lever for working the pump by hand when the ship has not sufficient motion."

There have been various devices, patented and unpatented, for working

pumps either by the rolling, or the way, of a vessel, possessing, of course, various degrees of merit. We do not think, however, that the one before us, although denominated an improvement, will justify the name; it must itself, we apprehend, be greatly improved, before it will perform its office well, or do more than occasionally deliver a few quarts of water.

268. For an improvement in the mode of constructing the *Hubs of Carriage and Waggon Wheels for containing Oil;* Abraham Randall, Vernon, Oneida county, New York, September 8.

These hubs are to be of cast iron; and it is proposed to cast them in three pieces, which are to be united together by means described in the specification. The main feature of novelty is the casting the parts hollow, so as to form large reservoirs for oil, which is to be poured in through openings closed by screws. Through the centre tube or box, which receives the axle, there are to be holes, communicating with these reservoirs, so as to keep up a continued lubrication. The claim is to "the casting of hubs with hollow compartments for containing the oil or other lubricating matter, having holes communicating with the axle; the compartments covered by screw boxes, substantially as above described."

Reservoirs for oil, in the hubs of wheels, are well known applications; the novelty, therefore, of the foregoing plan exists only in the particular way in which these are arranged and constructed, as making a part of a cast iron hub.

*For a machine for *separating Smut from Wheat;* Benjamin M. Smith, Rochester, Monroe county, New York; Patent dated August 1.

The claim to this machine is as follows:

"What I claim as my invention is the constructing of a machine for cleaning wheat or other grain, having a shaft with revolving disks, the upper surfaces of which are made rough by punching, or otherwise; which disks are surrounded by a case, the interior of which is also made rough by punching; and by the insertion of metallic points in alternate sections; the whole being constructed, and operating, substantially in the manner set forth. I also claim the vanes, as combined in this machine, and the particular manner of forming the step." The grain is to be let in at the upper end of the machine, whence it falls through a hole upon the upper revolving plate, where there are arms, or vanes, which throw it forcibly against the shell, or case. These vanes are to create a wind, by which the process of cleaning is to be aided. There also are to be similar vanes on the lower disk, which are to operate in a similar manner. One half of the outer case, in segments, is to be of sheet iron, punched, like a grater, from the outer to the inner sides, leaving numerous openings through which the smut, and other dust, may escape. The particular manner of forming the step consists in the surrounding it with an oil cup, within which oil is constantly kept, and upon which there is a cover to keep out dust. Analogous contrivances have been used, but probably not such as could be deemed identical.

269. For a machine for *Moulding and pressing Bricks;* Nathaniel Adams, Cornwall, Orange county, New York, September 8.

A cylindrical box is placed vertically, to contain the clay to be moulded. The bottom of this box consists of bars of metal at suitable distances for the clay to pass through to the moulds beneath, which are slid in under the bars, an empty set of moulds being made to push a full set out.

*The numbering of this patent is omitted, it having been noticed in the last list, by mistake. The present notice, however, is more full.

Within the cylindrical box, a vertical shaft is made to revolve by any suitable power, and upon this is placed what is called a circular inclined plane which consists of a plate of metal fastened to the shaft, and extending out so as nearly to touch the box; this plate forms a single thread of a screw, and by its revolution causes the clay to descend. An intermitting motion is given to the shaft, to prevent the descent of the clay during the time of changing the moulds; the contrivance for effecting this we cannot now describe, but it manifests ingenuity. The claim is to "the combination of the parts of said machine in the manner above described, or in any other manner substantially the same, for the purpose aforesaid; but no part separately, or independently of this combination."

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270. For an improvement in the construction of *Door Locks;* Turner Whitehouse, Boston, Massachusetts, September 8.

The whole of the proposed improvement consists in the employment of a number of friction rollers within the lock, for the purpose of making it work easily. There are two, for example upon the lock bolt, for the key to operate against; one larger one upon the dog, or tumbler, to receive the lift of the key; another upon the dog, or tumbler, for the spring to play against, which forces it down. The tumbler of the latch bolt, also, plays against friction wheels, there being three devoted to this object. The claim is to "the application of the several friction wheels, and the adaptation of the various parts of the lock for the reception of these friction wheels, as represented in the drawings."

One thing must be perfectly plain, namely, that by this application of friction wheels a lock is rendered much more complex than without them, whilst the main purpose of a lock, security, is not in any degree promoted; its liability to become foul, and to get out of order, will also be increased. The gain we think very trifling, as in a well made lock, the amount of friction is very small, so small that it is scarcely desirable to lessen it.

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271. For a *Non-radiating hot air Stove;* Benjamin Blaney, Boston, Massachusetts, September 8.

There is too much complexity in this stove for verbal description. In the drawing of it there are six different figures explanatory of its various arrangements. The claims are to "the application of the cold air to the inner surface of the outer case, over the whole space from the base to the top of the stove, by the mode in which it is admitted through the air box into the cold air chamber, and caused to circulate between the outside case and the loose case, and between the loose case and the perforated case, before it passes through the perforated case into the hot air chamber, to act upon the heated cylinder. Also the application of the loose case to the hot air stove for the purpose of preventing the direct rays from the heated cylinder acting through the perforations upon the outside case, in the manner described."

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272. For improvements in *Window Sash Springs* for upper sashes; Henry Hammond, Lewisburg, York county, Pennsylvania, September 8.

This improvement consists merely in so forming a spring for sashes, as that it may be applied to the upper as well as to the lower sash; the kind of spring alluded to is that which catches into notches, and holds the sash at various heights, having a thumb piece by which it is pressed back. The

claim made is to "the particular form and manner of applying the spring for the upper sash, as described."

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273. For an improvement in the construction of *Stoves;* George F. Hopkins, city of New York; Patent dated March 8.

This stove is made of cast iron, is open in front, and has a grate for coals which may be removed, for the purpose of burning wood. The sides of the stove are vertical, and are segments of a cylinder. There are two doors which are also segments of cylinders; which doors when drawn together close the front, and when opened, slide in grooves and run back so as to cover the side plates, with the curve of which they correspond. The back plate of the exterior of the stove is flat, and two or three shelves project out from it, for the purpose of sustaining articles which it is desired to keep warm. At the back of the fire place there is a cast iron plate, reaching from the top to the bottom of the stove. This also is a segment of a cylinder, standing with its convex sides towards the fire. Between the two back plates there is a space of about four inches, constituting a chamber, or reservoir, of heated air. The claims are to;

"1st. The employment of sliding doors, running in curved grooves formed in the upper and lower plates, to receive them, as set forth.

"2nd. The placing of metallic shelves against the rear plate of the stove, in the manner and for the purpose specified.

"3rd. The form and construction of the chamber essentially in the manner and for the purpose specified."

This stove is described with special care and minuteness, and the virtues of its construction and arrangement, dwelt on with much complacency, and that in several instances in which our perceptions have been too obtuse to enable us to discover the difference between the parts described and analagous parts in numerous other stoves. Judging from the drawing the stove has a neat appearance, and with the same supply of fuel which furnishes a given portion of heat in some other stoves, we have no doubt that this would behave equally well.

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274. For an improvement in the *Steering Apparatus for Ships, &c.* called Nicholson's steering wheel and guide; Samuel Nicholson, city of Boston, September 12.

The tiller is to be fixed in the rudder head, so as to stand a little above the deck, and upon the deck there is to be laid a frame, or platform, having a curved edge, adapted to the sweep of the end of the tiller. The curved edge of this frame is grooved so as to receive a tiller rope; this part of the apparatus is called the guide. Near the end of, and upon the tiller, there are to be raised two vertical posts, one behind the other, to support a common upright steering wheel, and the wheels by means of which it is to operate upon the guide. The steering wheel is fixed upon a shaft which has its bearings in the two posts; which shaft projects out through the hind post to receive the wheel. Upon this same shaft, between the posts is fixed a toothed driving wheel of six inches diameter, which mashes into a wheel below it of eighteen inches diameter, the shaft of which is also sustained by bearings in the two posts. Upon the shaft of this last wheel there is a drum, or whirl, of the same diameter with the wheel, grooved, and sufficiently thick, to receive the turns of the tiller rope, which is to be wound round it. On the under side of the tiller, small grooved pulleys, or sheeves, are so ar-

ranged as to conduct the tiller rope directly upon the grooves of the guide. The outer ends of this rope are attached to the hind part, or back of the guide, which is a semicircle, or nearly so. This constitutes the general arrangement of the apparatus, and it will be seen that by turning the steering wheel the tiller may be carried round. The patentee points out various modifications of his apparatus, and then says, "What I claim as my invention is the fixed and permanent guide, distinctly, and by itself; and then the combination of the guide with the cog wheels and cylinder, forming the machine above described.

"The advantage gained by the guide is the prevention of slack in the steering rope, so that where the tiller traverses the deck, the deck is kept unincumbered for the passage of men, spars, &c.; and at all times the movement of the steering wheel is immediately felt by the helm."

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275. For improvements in the *Machine for Pressing Bricks*; Andrew F. Mervine, St. Louis, Missouri, September 12.

The particular mode of arranging and guiding the levers in this press would require either an engraving or a very long description, to make them known; not because the machine is itself specially complex; but because an actual form which may be perceived and understood by a glance of the eye, may not be communicable in words, or may require too much circumlocution. The claims made are to certain peculiarities of arrangement.

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276. For *Machinery for making Bodies of Hats of Fur;* Henry A. Wells, J. James, and R. H. Peck, city of Brooklyn, New York, September 20.

This invention consists in the application of steam, issuing through openings in suitable tubes, upon a web of fur, which is wound upon cones by an improved apparatus, in which the transverse, vibrating, and rotary motions are so managed as to cause the various required operations to be simultaneously performed; the whole being "connected with the other operations provided for by said machinery, to form and harden a hat body, and prepare the same for the sizing operation, in a manner much easier, better, more expeditious, and cheaper, than has heretofore been done in any other way."

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277. For a *Stove, for Heating and Cooking;* Philip Wilcox, Springfield, Hampdon county, Massachusetts, September 12.

The claims are to certain things in which this stove is considered to differ from others, but they are not of a character to be made known verbally. The attempt to do this would generally produce more fatigue than edification. When patentees choose to furnish cuts, corresponding with their specifications, and exhibiting what they deem the characteristics of their inventions, we will insert them; in other cases we shall be compelled, most commonly, to "read them by their titles."

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278. For an improved *Planing Machine;* Alonzo G. Hull, Brooklyn, Kings county, New York, September 20.

In this machine the planing is to be effected by cutters placed upon the faces of wheels, or disks, which revolve vertically, as is the case with many other planing machines, and which, therefore, is not claimed. The pa-

tentee conceives, however, that his manner of combining the respective parts is substantially new, and makes claim to this particular combination. The planing is not to be effected by cutters upon a single wheel or disk, but on two or more in succession; against which the stuff is fed by means of an endless chain. The first of these wheels reduces the stuff in the manner of a jack plane, and it is subsequently smoothed by the others. The using of two or more such wheels, operating successively is claimed. The cutters on the reducing wheel are peculiar in their construction, there being four, or any other convenient number of, cutters set in one stock, so as to cut successively to different depths, in advance of each other; there is also a single cutter described and claimed, which has offsets causing it to operate in a manner analogous to those above noticed. Upon the smoothing wheel there are long cutters, or knives, extending from near the centre to its periphery, in a direction making an angle with the radii of the wheel. There are also shorter cutters arranged near the periphery, and face plates, to determine the thickness of the shaving; these are also claimed.

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279. For a machine for *Breaking and Cleaning Hemp and Flax*; D. M. Langley, and S. Davis, Westbrooke, Cumberland county, Maine, September 21.

In this machine there is a cylinder, the periphery of which is formed of slats passing from head to head, and resembling in form the slats on the bed of the ordinary break. This cylinder is placed in a frame so that it may revolve vertically, a small portion of its periphery projecting above the cheeks of the frame within which it revolves. There are two endless feeding aprons, one on each side of the cylinder, their upper surfaces being even with the top of the frame; upon these the flax or hemp to be broken is placed, and it is fed to the breaking cylinder by the revolving of these feeding aprons. A beater having three or more blades upon it, adopted to the spaces between the slats of the cylinder is hung by its outer end in a frame which stands at right angles to the main frame; and the outer end of this being acted upon by revolving cams, or lifters, causes the beater to rise, and allows it to fall by its gravity. By suitable gearing the cylinder of slats is carried round by an intermitting motion, as also are the rollers which carry the endless aprons; two blows are given by the beater between each movement of the cylinder. There are two pressing rollers, one over each of the inner rollers of the endless, or feed aprons, and between these and the aprons, the hemp or flax lies, they serving by their weight to hold it down as it is fed. The claim is to "the combination of the revolving cylinder breaker, with the beating breaker, and the aprons, as above specified."

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280. For an improvement in the *Machine for cutting Veneers;* Joseph Skinner, Stockbridge, Berkshire county, Massachusetts, September 29.

The description of this machine is of great length, and has reference to numerous figures in the drawings, of which we cannot attempt to give a general epitome. The veneers are to be cut by a knife made to traverse backward and forward, and the stuff to be cut is pressed by a roller along the point, or line, on which the knife operates, so as to prevent the cracking of the wood in advance of the knife. By this mode of cutting there is not any stuff lost, and the veneer is so thin that it may be rolled out of the way, as the cutting proceeds. The inventor says, "now what I claim as

my invention, is the use of a slide, or roller, in conjunction with a knife, or cutting tool, substantially as above described, for cutting veneers, or thin pieces of wood, for all useful purposes: the object of said slide, or roller, being so to compress the wood during the operation of cutting, as near as possible to the point of impact of the edge of the knife, or cutting tool, as to prevent the wood from parting, or separating in the grain, in advance of the knife."

"A knife and compressing slide, or roller, for cutting upon the above described principle, may be greatly varied with respect to both form and movements. The mechanical arrangements necessary for making the fundamental principle available, may be greatly varied, so as to cut either endwise, obliquely, or from a round log. Hard timber may be softened by steam, or otherwise heating, to facilitate the cutting the veneers, and to render them more pliant and yielding."

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281. For an improved *Pantaloon Measure*; Edwin Grimston, Danvers, Essex county, Massachusetts, September 21.

It will appear from the claim made that this instrument is constructed upon philosophical principles; the claim is in the following words:

"What I claim as new in this instrument in the measuring for Pantaloons, is the particular construction and arrangement of the respective slides, with their appendages, working upon a perpendicular bar, in the manner described; with the application thereof, to the ascertaining of the curves of the leg and body, by measuring their deviation, precisely, from a perpendicular, or other fixed line."

A vertical rod, four feet long, is to rise from one side of a horizontal platform placed upon the floor; upon this vertical rod there are four slides which may be slid up and down upon it, and be tightened by screws at different heights. These slides carry others which pass through mortises in them, and slide horizontally; the whole being graduated into inches and parts of inches. The person to be measured stands upon the platform so that the outside of the calf of the leg and also the hip, or body, just touch the vertical rod. The first slide is then placed opposite the hollowest part of the waist, and its horizontal slide pushed through so as to touch the body. The second slide is then so placed as to bring its curved bar between the legs, close up to the crotch; the third slide opposite, to the most concave part of the outside of the knee, and its shaft pushed through so as to touch the leg at this point. The fourth slide is to stand at that point of the ancle where the pantaloons are to terminate. The distance from the first to the fourth slides gives the whole length of the pantaloons, and the other slides give the variation of the respective parts from the perpendicular, and consequently the curvature to be observed in cutting, with the other information necessary to this process.

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282. For an improvement in the mode of *Supporting the Bodies of eight wheeled Rail Road Cars, and Carriages;* Richard Imlay, city of Philadelphia, Pennsylvania, September 21.

"The nature of my invention consists in placing two cylindrical plates one above the other, in the middle of the carriage, at each end of the car, so that the under one being confined to the body of the carriage, the springs to the upper one, and they connected to the body of the car, there-

by allows of any movement in turning curves, and also a complete rotary motion if desired."

The device above referred to consists of two cast iron wheels, like fifth wheels of a carriage; one of them, which may be two feet in diameter, is fixed firmly on to the centre of the transverse rail of the carriage. It has a stout rim rising vertically at its periphery, the whole being turned perfectly true. A second wheel, also of cast iron, fits into this, and has a bearing upon the lower one, of about four inches in diameter, near the centre. A flanch upon this second wheel covers the rim of the first but does not quite touch it, this being prevented by the centre bearing. The carriage is to rest upon the upper side of the second wheel. To this upper side are also attached three bars of spring steel, parallel to, and at a small distance from each other; these are to be of such length as to be received in pockets, or have their bearings otherwise, upon the side rails of the cars, by which means they become the springs upon which the carriage rests. The claim is to "the vibrating cylinder plates as set forth in the specification, whereby to support all kinds of eight wheeled rail road carriage bodies upon springs."

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283. For an improvement in the *Machine for making Wrought Nails;* N. W. Bishop, and Simon Brooks, Saybrook, Middlesex county, Connecticut, September 21.

The nails are to be fed in between vibrating dies sustained on two horizontal shafts one above the other, toothed gearing causing the shafts to vibrate in unison. One half the die of the upper shaft is capable of a lateral motion, and recedes from the other half, to allow the feeding, but when vibrating back again it is closed and presses the nail laterally, whilst the die on the lower shaft forms it longitudinally. There are also heading dies worked by a toggle joint, and the necessary apparatus for cutting the iron to the proper length. It will be seen that the general principle upon which this and some other wrought nail machines, operate, is the same; the peculiar arrangement only can be claimed.

"We do not claim the making of wrought nails by means of vibrating dies, nor do we claim the use of toggle joints for the opening and closing of dies generally, they having been before used. But what we do claim is the particular arrangement of the toggle joints as herein described, for the opening and closing of the dies, and also for the heading of the nails; this manner of using being, as we verily believe, new, and of our invention."

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284. For an improved method of *Preserving Timber and other vegetable products;* granted to John Knowles, and Robert Gilbert, executors of the estate of Robert Bill, of Great Britain. Auguste Gotthilff, of New York, their Attorney, September 21.

The claim will afford an adequate idea of the nature of this invention, viz:

"What is claimed as new, and as constituting the invention of the before named Robert Bill, is the saturating timber of all kinds with mineral tar or pitch, by covering the same therewith in suitable troughs or tanks, in which it is subjected to the action of heat, in the manner described; which saturation is for the purpose of preserving it from destruction by worms, from dry rot, or from decay from other causes. And also the saturating of

the fibres of hemp and other vegetable substances of which ropes are manufactured, with mineral pitch or tar, as obtained from mineral coal, either alone or in combination with the spirit of coal tar; and in the case of the material for ropes, in combination with turpentine, as herein described, applying the same in all cases at a temperature, and substantially in the manner, set forth, and including under the general denomination of mineral pitch, that species known by the name of asphaltum, or jew's pitch."

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285. For an improvement in the mode of making a *Batting, or Web for Hat Bodies;* Henry A. Wells, James James and Robert W. Peck, city of Brooklyn, New York, September 22.

This patent is taken for improvements on a machine invented and patented by Thomas Blanchard on the 14th of June 1837, and noticed at p. 176 of the last volume. The variations specified are ten in numbers, and the claims are to "the several additions to said machine, as specified, in their combination and connexion therewith."

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286. For an improvement in the composition of matter for *Fire Bricks:* Christopher W. Fenton, Bennington, Vermont, September 22. (See Specification.)

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287. For an improvement in the mode of *Regulating the temperature of Inking Rollers, &c.;* E. W. Arnold, Boston, Massachusetts, September 21.

A hollow metallic drum is to be made of the usual size of inking drums; which drum is to receive the ink from a common distributing roller, like those now used, which take it from the ink fountain underneath; inking rollers of the ordinary construction are to take the ink from this roller and distribute it on the form. One of the gudgeons of the metallic drum is to be hollow, and by means of this opening a pipe is to be introduced through which water may flow into the interior of the drum. This pipe is connected with a reservoir, which may be elevated about a foot above the level of the drum, and is to contain water either warm or cold, according to the temperature desired to be given to the drum. A waste pipe furnished with a stop cock, is also attached, by means of which the water may be drawn off. The claim is to "the heating and cooling, and regulating the temperature of inking rollers and ink, in the operation and process of printing, by the means aforesaid."

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288. For an improvement in the *Endless Chain Horse Power;* Jacob G. Hall, Zanesville, Ohio, September 21.

The improvement claimed consists in the form given to the links by which the slats, forming the revolving floor, are connected together; oval and semi-oval links being employed alternately, the latter embracing the slats of the floor. A claim is likewise made to the manner of constructing the endless chain of rollers, by passing the axles, or round rods on which they revolve, through the rollers and links, without riveting, or other fastening, and retaining them in their places by means of boxes, or troughs, the sides of which prevent their falling out.

289. For an improvement in the *Endless Chain Horse Power;* Aaron Palmer, Akron, Erie county, New York, September 22.

The links which join the slats are made in a peculiar form, having hinge joints, and straps which lap in such a way as to afford considerable sustaining power to the slats. The knuckle of the joint comes under the centre of each slat, a strap extending from joint to joint. In the drawing no other support is represented as being given to the floor upon which the horse is to walk. This will not answer in practice, the whole sustaining power being the joint pins, or the straps.

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290. For an improvement in the *Slide Valves of Steam Engines;* for which a patent was granted to him on the tenth of July 1834; John Kirkpatrick, city of Baltimore, September 22.

This patent is taken for an improvement in the manner of carrying out the original plan of the patentee, by which the valves are intended to work with but little friction.

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291. For an improvement in the mode of *Causing Puppet Valves to work light;* John Kirkpatrick, city of Baltimore, September 25.

The object in view in this improvement is to "cause the unequal action of springs to counteract the unequal action of the puppet valves in opening and shutting. As the valves push much harder when nearly shut, the spring being forced down by the valves in shutting, offer the greatest resistance at that time, and in rising they cease to act as the valves cease to require that action." The claim is to "the application of springs as described, either with or without the piston, to cause puppet valves to work light, using for that purpose any kind of springs best suited to the particular arrangement of the engine to which it is applied."

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292. For improvements in the *Apparatus for Generating Steam in Cooking*; John Bouis, city of Baltimore, September 21.

In the specification of this patent, a long description is given of the mode of conveying steam from a boiler, to perform culinary operations, to heat baths, and for other purposes; but not presenting any thing that is new. The only thing claimed is "the form and construction of the boiler;" which is to be made of boiler iron, "in the form of the false back of a fire place."

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293. For an improvement in the *Galley and Cooking Stove for Vessels, and Domestic uses;* Benjamin Spratley, Portsmouth, Norfolk county, Virginia, September 25.

Like stoves in general, especially those of a complicated character, the claims would not afford any insight into the particular arrangement upon which the claim to novelty is founded.

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294. For an improvement in the *Hydraulic Current Wheel;* Warren P. Wing, Greenwich, Hampshire county, Massachusetts, September 22. (See Specification.)

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295. For an improvement in the *Horizontal Water Wheel;* Chapman Warner, Oxford, Warren county, New Jersey, September 22.

A cistern, in the form of a vertical cylinder, is placed so as to stand on

the sheeting prepared for it at the lower part of a fall of water. This cistern has a hole in its centre through which the water is to escape, after it has acted upon the water wheel, the bottom of the cistern, or cylindrical reservoir, being sufficiently elevated above the sheeting, by means of blocks, for the water to pass out readily. A vertical shaft runs on a step upon the sheeting, in the centre of the opening above mentioned. From this shaft extend out six buckets, or vanes, upon which the water is to operate. These are surrounded by a rim having six openings through which the water is to pass to act upon the vanes, these openings are formed by curved pieces constituting the rim, arranged in the manner of the buckets in Wing's and other reaction wheels. There is a close cover fitted on to these rims, and securely bolted down. From the centre of this cover a tube is elevated through which the shaft of the water wheel passes, the tube rising sufficiently high to prevent the head of water admitted into the cistern from flowing over.

The claim is to "the application of a close chamber, or cistern, in combination with the before described water wheel, in which the water is received and made to strike all the buckets simultaneously, before it passes out at the bottom."

Like the class of wheels, denominated reaction wheels, that just described, will be very wasteful of water; where this is of no importance it may, from its simplicity, be useful; but whether better than the reaction wheels, in any respect, experience must determine; we see no reason, however, why it should be so.

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299. For an improvement in the *Manufacture of Sugar*; John Penny, and William Toland, Parish of Ascension, Louisiana, September 25.

"The object in view is to obtain a complete command of the necessary degrees of temperature, both in heating and cooling the pans, kettles, boilers, or clarifiers employed; which is effected by means of dampers and air flues, the former shutting off the heat at pleasure, and the latter admitting a current of cold air to circulate round the vessels when the heat has been shut off, and it becomes desirable to produce a rapid cooling." After this preliminary remark the specification proceeds to describe the particular manner in which the boilers are set, and the furnace and flues so constructed that by the aid of sliding shutters, or dampers, the heat may be regulated under each individual vessel, or cold air may be admitted in a rapid current whenever its influence is desirable.

The claims made are to "the application of heat, from one furnace, to the evaporating kettles, the granulating pan, and the clarifiers, in the manner set forth; in combination with the means of managing that heat by the aid of dampers, and the introduction of cold air into the space surrounding the clarifiers and crystallizing pan; the whole operating on the principle, and applied to the purpose described.

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300. For an improvement in his Patent *Lamp;* Samuel Rust, city of New York, September 25.

The patentee has made several successive improvements in his lamp, which he has made the subjects of patents. The present claim is to the particular manner in which he inserts a roller for raising the wick into the stopple of his lamp; in a more recent patent, which will be hereafter noticed, another arrangement for raising the wick, still more simple in its character, has been described.

301. For an improvement in the *Mode of Supplying Air to Wood and Coal Stoves;* Frederick Fickhardt, Easton, Northampton county, Pennsylvania, September 25th; patent dated March 25.

The object of the arrangement made in this stove is to supply heated air to the combustible; which heat is to be abstracted from the products of combustion as they escape in the smoke flue. For this purpose different arrangements may be made according to the form of the stove; the following may serve as an example. A smoke flue may surround an oven in the ordinary way; the cold air may be admitted through an opening at the lower end of the back plate of the stove, leading into a flue between the bottom plate of the stove, and the bottom plate of the smoke flues. The cold air thus admitted arrives under the grate bars at the front of the stove, and feeds the fire. In passing from this, around and under the oven, the heated air warms that which is admitted through the back plate. The claim is to the air flue, in the connexions above given.

302. For a *Parceling Machine;* Obed Kempton, New Bedford, Massachusetts, September 25.

The process of parceling is the spreading of tar upon canvass for the purposes of the rigger; the machine which is the subject of the present patent is for effecting this object in a more expeditious and economical manner than heretofore. The claim will show with sufficient clearness the general construction of the machine.

"What I claim is the making of parceling by passing the canvass, or cloth, over a cylinder, which revolves in a pan or trough containing heated tar, and winding the canvass upon a spindle, the cylinder having a scraper placed at any distance from its surface to scrape off the superfluous tar; and the box or trough being placed upon a furnace or stove, all as above described."

303. For an improvement in *Many Chambered Fire Arms;* Curtis Parkhurst, Lawrenceville, Tioga county, Pennsylvania, September 25.

In this gun the chamber is a segment of a cylinder, instead of being a complete cylinder, as in Cochran's; the chambers are bored in at the periphery, towards the centre upon which the segment is to revolve; there being a slat, or mortise, to receive it, in the rear of the barrel; the other parts are so arranged as to adapt themselves to the construction of the chambered segment.

304. For an improvement in the mode of *Setting Axletrees, and in the Machinery therefor;* Timothy Fessenden, Boston, Massachusetts, September 25.

The object in view is to set the axles of carriages so that each shall have the same inclination from a horizontal plane; and consequently, when wheels are dished, to cause them to be equally so.

The apparatus claimed is a species of gauge, to be applied to the axle, after the round or conical ends have been turned, and the two parts welded together. The axle may be laid on a bench, and the gauge applied. This gauge consists of a straight bar of sufficient length, and it has on it three sliding pieces, capable of adjustment, which project at right angles from it. The extreme ends of two of these slides are to be so adjusted as to come into contact with one of the journals of the axle, one of them near its end, and the other near its shoulder; the third gauge piece, at the opposite end of

the long bar, being placed in contact with the opposite journal, near its shoulders. If these three points are in contact, and on being reversed are still in contact, the journals are true with each other; if not they require setting. The claim is to the mode of setting the axles, and to the apparatus as described.

Had we been engaged in the business of setting axles, we certainly should have resorted to some mode substantially the same with the foregoing, and should have done this without being sensible that we had made any invention or discovery.

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305. For an improvement in *Stoves*; Thomas Mills, Havanna, Chemung county, New York, September 25.

This is a species of box stove, for heating. The bottom, if bottom it can be called, consists of two plates, each reaching from near the lower edges of the side plates to the middle of the top plates, leaving an open space from front to rear of the stove, in the form of a common tent. There are ribs on the interior of the plates for the fuel to rest against. The fire chamber consists of two compartments, both of which are to be supplied with wood. The claim is to the making two chambers of combustion, by the arrangement of the plates as described; also to the projections on the insides of the plates, and double sunk hearths, in the manner in which they are combined.

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306. For improvements in the *Water Wheel, and the Mode of letting Water on the same;* Samuel Curtis, Eagle, Alleghany county, New York, September 28.

Perceiving nothing in this wheel to recommend it, as superior to others, and believing that instead of being so, it will disappoint the hopes of its projector, we shall give only the claim.

"The invention claimed by me consists in the manner of introducing the water inside the wheel, and causing it to act by percussion as well as reaction, as above described; and the mode of forming and adapting the buckets thereto."

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307. For an improvement in the *Mortise Latch for fastening Doors;* Charles S. Gay, Nashua, Hillsborough county, New Hampshire.

In this instrument a spring latch is protruded, and drawn back, by a knobbed handle in the ordinary way. The novelty consists in what is called a rotary guard, which is to be turned by means of a key, and which catches upon the bolt so as to prevent its being withdrawn until the guard is turned back again, thus making it answer the purpose of a lock. The claim is to this rotary guard. The latch deposited in the patent office is a good one, being well made, and not liable therefore to get out of order. As to the rotary guard, it will certainly answer the purpose intended perfectly well; few things, however, would be more easy than to devise a dozen modes equally good.

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308. For an improvement in the *Mortise Latch for Fastening Doors;* David N. Ropes, Portland, Maine, September 28.

This latch is a spring lifting latch, operating in the manner of the lifting latches which are used in the modern imported English patent door locks. It is made in a very simple manner, which is its only merit. The latch

part is made of iron, and upon the top part of this a narrow strip of steel is riveted which extends out behind it, and is firmly fastened to the box or plate of the latch. This spring forces the latch down, and it is raised by a lifter on a knobbed handle, in the usual way.

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309. For *Drafting out the fore part of Coats;* Allen Ward, city of Philadelphia, September 28.

We are informed by the patentee that "the following draft, or diagram of a coat will show the practical tailor how to produce the balancing points of coats according to the new method, with about half the labour usually bestowed for that purpose." Those interested in the invention or discovery may obtain the said drafts at the patent office. Were there any probability that this great improvement would lessen the charge to the consumer of coats, we would take some trouble to make it known, as this would be a balancing point of general interest; of this, however, we have no hope, but, on the contrary, apprehend a charge for the patent right.

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310. For an improvement in the *Machine for Cutting Leather;* Levi N. Leland, Grafton, Massachusetts, September 28.

This is a machine intended principally for cutting out the soles of boots and shoes. The leather is first to be cut into strips of a proper width; that is, equal to the length of the sole to be cut. A sliding frame, acted upon by a rack and toothed wheel, is placed upon a frame within the cheeks of which it slides horizontally. Knives of a proper curvature cross this frame from side to side, being held in grooves prepared to receive them. The edges of these knives are upwards, and are all on the same horizontal plane. A cylinder, which may be turned by any adequate power, crosses the machine above the edges of the knives, and has toothed wheels on each of its ends which take into the racks upon the knife frame. The cylinder is adjustable, and its periphery bears upon the edges of the knives. When the leather is passed between them, it will be cut, as desired, and will fall through between the knives.

The claim is to "the cylinder in connexion with the carriage under it, the slide placed in the carriage, and the knives inserted in the slide, and the mode of regulating them, as set forth."

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311. For an improvement in the *Endless Chain Horse Power;* Henry G. Hall, Putnam, Muskingham county, Ohio, September 28.

The difference between endless chain horse powers, for which patents are claimed, is frequently as small as that existing between cylinder thrashing machines. Care, of course, is taken in the office to confine the claims, in these cases, to those things which appear to be actually new, and, however small such a thing may be, if it have the character of novelty, and appears to be substantially different from what has preceded it, no more can be required; its importance is a question between the patentee and the public. The claim in the present instance is to an "additional link for strengthening the chain," so as more securely to bear the weight of the horse.

Specifications of American Patents.

Specification of a patent for a composition of matter for the manufacture of Fire Bricks; granted to Christopher W. Fenton, *Bennington, Vermont, September 22nd,* 1837.

The nature of my invention, or discovery, consists in mixing, in the manufacture of fire bricks, the following substances, to wit: the earth usually denominated kaolin, or porcelain clay, and fine granular quartz, or white sand, or sandstone, frequently, if not commonly, used in the manufacture of glass; which bricks, when shaped, and sufficiently dried, are baked in a high heat.

To enable others skilled in the art to make and use my invention, I will now describe the manner in which I proceed. I compose the said fire bricks of the said kaolin or porcelain clay, and fine granular quartz, being a species of pure white sand, or sandstone, as before mentioned, in equal parts, or in any other available proportion, though I prefer equal parts, or nearly so. These two substances being intimately mixed together and moistened with water, so as to bring the whole to a proper consistency, I then shape the mass into bricks, or other blocks, by the aid of moulds, after the common manner of making bricks. When these bricks are sufficiently dried I bake them in a high heat; they are then fit for use, and will resist a greater degree of heat than any other substance or composition of matter known to the inventor as applicable to this purpose.

What I claim as constituting my invention and discovery, and wish to secure by letters patent, is the using and applying the aforesaid substances, known under the name of kaolin, or porcelain clay, and granular quartz, being a species of white sand, or sandstone, frequently used in the manufacture of glass, in the manufacturing of fire bricks; which fire bricks are capable of resisting an intense heat; and I claim the composing said fire bricks of these substances in any proportion, be it in equal or unequal parts.

Christopher W. Fenton.

Remarks by the Editor. The testimonials respecting the goodness of the bricks made by the patentee are satisfactory upon that point, as they have been well tested, and compared with others, in iron furnaces. The term kaolin, or porcelain earth, is not a very distinctive one. The substance so called by us, is not identical with the true kaolin of China; and it will be found to differ in the proportion of its constituents in different localities; that used by the patentee offers no assurance therefore, that the material known by the same name in another place, will possess like refractory properties.

Specification of a patent for an improved current water wheel; granted to Warren P. Wing, *Greenwich, Hampshire county, Massachusetts, September 22nd,* 1837.

To all whom it may concern, be it known, that I, Warren P. Wing, of Greenwich, in the county of Hampshire, and State of Massachusetts, have invented certain improvements in the hydraulic current wheel, by means of which the flowing of a current, or tide, may be more efficiently applied than it has been heretofore to the raising of water,

or to other purposes for which power is required; and I do hereby declare that the following is a full and exact description thereof.

For the sake of facility of description I will give the form and dimensions of one which I have put into operation, and which has been found to answer well in practice. The wheel consists of a shaft upon which are placed flights, or buckets, against which the water is to strike and give motion to the shaft, the flights being placed obliquely thereon. The shaft of this wheel, is thirty feet long, and eight inches in diameter; its form is octagonal. Into four of the sides I insert seven flights or buckets, making twenty eight in the whole. At one end of the shaft the flights are twenty inches long, and at the other end forty, the intermediate flights increasing equally in length from the shortest to the longest. They are each about eight inches wide near the shaft, and spread out in a fan-like form, so that their extremities occupy about one eighth of the circle, or circumference, of the wheel. The flights or buckets are flat on the face and they are set so as to form an angle with the axis of the shaft, usually of about thirty degrees; but this angle will vary according to the velocity of the current, and accordingly as the shaft varies more or less from the line of direction of the current: a distinguishing characteristic of my wheel being the placing of the shaft so as to form an angle with the direction of the stream both vertically and horizontally. The buckets, or flights, may be of iron, or other material. The wheel is to be placed so far below the surface as to be out of the way of floating ice, &c.

The shaft, as above intimated, is to be placed obliquely to the direction of the current. In a wheel of the size mentioned it may vary about six feet from the direct line, both horizontally and vertically, by which means the force of the water upon the flights will be greatly increased. Two or more such shafts may be coupled together, and to prevent inconvenience from their great depth in the water, the angles of the shafts with the current may be reversed, so that whatever their number their depths below the surface will remain the same. From the gudgeons of the shafts the power may be communicated in any convenient way.

I do not claim as new the employment of wheels consisting of a shaft furnished with flights, or buckets, these having been used; but what I do claim is the increase of the length of the flights so as to give to the outside of the wheel the form of the frustrum of a cone; and also the placing of such shafts in the current so as to form a decided angle therewith, in the manner described.

WARREN P. WING.

Specification of a Patent for a process for protecting articles made of Iron or Steel from oxidation. Granted to M. SOREL, *of the city of Paris, in the Kingdom of France. December,* 1837.

To all whom it may concern; be it known, that I, M. SOREL, of the city of Paris, in the Kingdom of France, have invented, or discovered, a process, method, or methods, by which various articles made of iron or steel, may be effectually preserved from oxidation, or rusting, by the galvanic action produced by zinc, and I do hereby declare that the following is a ull and exact description thereof.

It is well known to chemists and to all persons versed in the physical sciences, that a galvanic action is produced by the contact of two metals different in their natures, and that the most oxydable of the two metals so brought into contact becomes positively electrified; whilst that which is least oxydable becomes negatively electrified, and also that, when brought into this state, the most oxydable, or positively electrified metal, has a tendency to become oxidized, and will abstract oxygen from compounds containing this agent; whilst the least oxydable of the two metals will be protected from oxidation, although exposed to agents which would oxidize it, but for the contact of the negative metal. My process depends, for its efficiency in protecting iron and steel from oxidizing, or rusting, upon the manner in which I apply this principle.

The process of covering articles of iron with tin is well known, and is exemplified, most largely, in the manufactory of what is usually known under the name of sheet tin, or tin plate, which consists of thin sheets of iron coated with tin. In this material there is necessarily galvanic action between the two metals, but it is to the disadvantage of that which it is proposed to protect, namely, the iron, which being more oxydable than tin, becomes positively electrified, and has its tendency to rust increased; the protecting effect of the tin depending in this case entirely upon the perfectness with which the iron is coated by it; as is clearly evinced by the rusting of the iron whenever any portion of this coating is removed, and the iron is exposed to the action of air and moisture. Were the galvanic action in favour of the iron, it would be protected notwithstanding the abrasion of the tin, as its protecting influence is not limited to the mere point of contact, but extends far beyond it.

In the scale of the oxidability of the different metals, commencing with those which are the most oxidable, it has been found that zinc stands before iron, and it follows, therefore, that when these two metals are brought into contact, a protecting influence will be exerted upon the iron by the zinc, and that the rusting of the former metal will be thereby prevented.

It might be supposed, from the fact that zinc is more oxidable than iron, that this metal, if employed to protect iron, would itself soon become oxidized, or rusted, and would, consequently, leave the iron unprotected; and such reasoning would undoubtedly be just, but for another fact, well known to chemists, that there are certain metals, of which zinc is one, which after they have acquired a thin superficial coat of oxide, are thereby effectually protected from the further absorption of oxygen, under ordinary exposure.

Having thus fully exemplified the principle upon the application of which my process is dependent for its efficacy, I will now proceed to give the necessary details, and the various modes which I have devised, for carrying the same into operation. These modes which I have essayed, are five in number, and are as follows:

First, applying the zinc to the iron or steel in the manner in which tin is applied in the process of tinning.

Second, applying a galvanic powder in the manner of paint, which consists in mixing the zinc, reduced to fine powder, with oils, or resinous materials, so as to form a paint or varnish, with which the substances to be protected are to be covered, in the ordinary manner of painting, or varnishing.

Third, covering the articles to be protected, with the galvanic powder, consisting of zinc finely comminuted.

Fourth, wrapping the articles to be protected in what I denominate galvanic paper.

Fifth. Anointing or covering the articles with a galvanic paste, consisting of any suitable fatty matters, such as purified lard, in which the galvanic powder has been freely mixed.

The first process, that of coating the articles to be protected with metallic zinc, is to be effected much in the same manner in which tinning is performed, that is to say, the articles to be coated must be rendered clean, and free from oxide, by processes analogous to those followed in preparing them for ordinary tinning; such as immersing them in diluted sulphuric or muriatic acids, scouring them, and so forth; which processes being well known, need not to be described. The zinc, in like manner, must be fused in proper crucibles, or other convenient vessels, adapted to the nature and size of the articles to be operated upon; special care being taken to keep the metal covered with sal ammoniac, or other proper flux; and to regulate the heat in such way as is required by the volatile nature of the metal. The articles to be coated, after being dipped into the melted zinc, are to be withdrawn slowly, that too much of the metal may not adhere to them. They are then to be thrown into cold water, rubbed with a sponge, or brush, and dried as quickly as possible, as otherwise they may be injured by the appearance of dark spots, which it is desirable to avoid.

When chains for cables, or for other purposes, are being withdrawn from the zinc, they must be shaken until sufficiently cooled to prevent the links from being soldered together by the melted metal. The coating of small chains requires careful management, but by the following procedure it is effected without difficulty. Whilst in the dilute acid, they are to be moved about to expose all their parts equally to its action, they are then to be dipped into muriatic acid, and immediately dried in a reverberatory furnace. The melted zinc being ready, and covered with sal ammoniac, the chains are to be put into it, and suffered to remain there about a minute; they are next slowly taken out by means of an iron skimmer, or other convenient instrument, which will allow as much of the zinc to drop from them as can be got rid of in that way; the links, however, will still retain too much zinc, and will be soldered together. To correct this they are to be put into a reverberatory furnace, to be covered with charcoal, and retained at a red heat for about a quarter of an hour, during which time they are to be moved about by means of an iron poker; by this treatment the excess of zinc will be discharged; they are then to be drawn towards the mouth of the furnace where they are kept in motion until the zinc is solidified. When small nails, and such like articles, are to be coated, the process should be performed in small crucibles, this being necessary to prevent the danger of spoiling a considerable portion of zinc, which results when iron has been kept in it for a considerable length of time, as it is thus rendered unfit for the purpose of a protective coating. In all cases the purest zinc should be employed. Wire may be coated by passing it through the melted zinc, as it is wound of from one drum or reel, on to another.

When articles of iron have been coated with zinc, it is sometimes desirable to cover this coating with one of tin; more especially when culi-

nary vessels are the subjects of the operation. It may also be resorted to when it is desired to give a brighter and more handsome surface than the zinc affords; such a coating of tin will not destroy the galvanic effect of the zinc; and it is to be effected in the ordinary way of tinning, particular care being taken not to heat the tin too highly, or to keep the articles in it so long as to remove any portion of the coating of zinc.

The galvanic powder, consisting of zinc reduced to that state, may be obtained by various means; the following, however, I have found to be the most economical of any which I have essayed.

The zinc is put into a reverberatory furnace, and brought nearly to a red heat, care being taken to prevent the access of a current of air; it is then carefully skimmed, and covered with sal ammoniac.

Iron filings, equal in weight to about one tenth part of the zinc, are to be moistened with muriatic acid, and thrown on the fused zinc; the whole is to be covered with finely pulverized charcoal, and the heat of the fused metal raised to whiteness, and so retained for a quarter of an hour, agitating it at intervals by means of an iron poker. The melted mass is then to be run off into a brick or cast iron reservoir, which is covered with a plate of cast iron, to prevent the combustion of the zinc. Through an aperture on the cover, a poker, or stirrer is to be introduced to agitate the alloy, which is to be done until it is cool, when it will be in fine powder.

The galvanic paint is prepared by grinding this powder with the fluid which is to be employed to form it into a paint, or varnish. Various fluids may be used for this purpose. I have sometimes employed the oil distilled from coal tar. Coal tar itself answers well, with the addition of one third of spirits of turpentine, or of a sufficient quantity to bring it to a proper consistence. For purposes where the odour of this mixture would be objectionable others may be substituted.

Articles of polished steel, or iron, packed in this galvanic powder, so as to be covered thereby, will be preserved from oxidation, even should they become moistened from any accidental cause.

Galvanic paper may be prepared either by the mixing of the powder with the pulp in the manufacturing of the article, or by taking the ordinary wrapping paper, coating it with any suitable adhesive substance, and sifting the galvanic powder over it. Polished, or other, articles, wrapped in such paper, will be effectually protected from rust by the galvanic action.

The preparation of the galvanic paste has been sufficiently explained, and its operation in protecting the articles coated with it will be readily understood, as it is analogous in this respect, to those previously described.

Having thus fully explained the principle upon which my process of protecting iron and steel from rusting, or oxidating, is dependant; and having also given the various modes in which I have contemplated the carrying the same into effect, I do hereby declare that what I claim as of my invention, and wish to secure by letters patent, is the employment of zinc, in various forms, as a covering to the respective articles to be thereby protected, as herein set forth. I do not claim to be the discoverer of the principle of the protection of metals from oxidation by galvanic action; nor do I claim to be the first to have proposed the employment of zinc for the preserving of iron therefrom; masses of zinc having been

applied, or it having been proposed to apply it in masses, to steam engine boilers, and probably to other articles, with this intention; but from this, my plan, or mode of procedure, differs as obviously as it surpasses it in efficiency, and in its applicability to numerous purposes in the arts where the application in masses would be impossible, or altogether unavailable.

SOREL.

Progress of Practical and Theoretical Mechanics and Chemistry.

Templemoyle Agricultural School.

Any one who duly reflects upon the infinite importance of giving to the youth of our country, an education wisely adapted to their prospects in life, —to the peculiar character of an American citizen,—to the nature of our Institutions,—to our social polity and republican habits,—must, we think, regret the failure of the bill so favorably introduced into the Legislature, and so ably supported, of establishing a School of Arts under the supervisions and management of the Franklin Institute. It might be difficult to add much to the arguments so forcibly urged by the principal advocates of the bill; and we cannot but believe, that extended observation and maturity of reflection will eventually satisfy every parent and guardian that he could make no better provision for the prosperity of a son or a ward, destined to fill an active and productive sphere of life, than to place him in a school where, in addition to the requisite amount of literary instruction, he may acquire a knowledge of those practical sciences, to which his time and energies must necessarily be devoted. Such a school as that whose outlines and objects were presented to the Legislature, would furnish incalculable advantages to those who have in prospect an engagement in any of the arts, trades and manufactories which are becoming so immensely important to the wealth of our country. To those whose views are more exclusively agricultural, such establishments as the one described in the subjoined article would be worthy of all imitation.

G.

To the Editors of the Irish Farmer's and Gardener's Magazine.

GENTLEMEN—You will render a service to Ireland, and advance the interests of that branch of her industry (agriculture) whence she derives her principal resources, by giving a place in your widely circulated pages to the following account of an establishment now in operation for ten years, the extension of which, and the formation of similar schools elsewhere, are the sole rewards aimed at by the noblemen and gentlemen who were the founders of it, of whom many are still zealous, as the committee of management, in promoting its success.

I have the honor to remain, Gentlemen, Your obd't humble serv't,

ONE OF THE COMMITTEE.

The Agricultural Seminary of Templemoyle originated at a very numerous meeting of the Northwest of Ireland Farming Society at Londonderry, and it was at first intended that it should consist of two establishments, taking Mons. Fellenberg's Institution at Hoffwyll in Switzerland in some degree as the model: the first to be a school affording instruction in every science and accomplishment aimed at by the children of the higher orders; the second for the education of the sons of respectable farmers and tradesmen, in the hope of disseminating the advantages of an improved system of

farming with greater certainty, by combining the practice and theory of it in the instruction of those who were afterwards to make agriculture their pursuit. It was hoped that the extended scale of the institution would have allowed of a greater variety of masters and lecturers, and that the profit derived from the superior school would have contributed towards the maintenance of the secondary one; but a short experience convinced the subscribers that such a scheme was impracticable without much larger and more certain funds than they could rely on; they then gave their undivided attention to the agricultural seminary, which through their increasing exertion has attained such eminence as may justly entitle them to look forward with confidence to its increasing usefulness, and to its becoming a model for establishments of a similar nature in other parts of Ireland.

The school and farm of Templemoyle are situated about six miles from Londonderry; about a mile distant from the mail-coach road leading from Londonderry to Newtowlimavady. The house, placed on an eminence, commands an extensive and beautiful view over a rich and highly cultivated country, terminated by Lough Foyle. The base of the hill is occupied by a kitchen and ornamental garden, cultivated by the youths of the establishment, under an experienced gardener. The ground between the garden and house is laid out in beds in which all the different grasses, clovers, &c., are cultivated with the greatest care. The house is in the form of an ||═||, with ranges of farming offices behind, containing spacious, lofty, and well ventilated school-rooms; refectory, dormitories, apartments for the masters, matrons, servants, &c.

Each pupil occupies a separate bed; the house can accommodate seventy-six, and the number of pupils amounts to sixty. They receive an excellent education in reading, writing, and arithmetic; book-keeping, mathematics, land-surveying, and geography. This department is managed by an excellent head master and assistant master, both resident in the house. The pupils are so classed that one-half are receiving their education in the house, while the remainder are engaged in the cultivation of a farm of 130 Cunningham or 165 statute acres, in the management of which they are directed by the head farmer, an experienced and clever man, a native of Scotland, who has a skilful ploughman under him. The pupils who are employed one part of the day on the farm, are replaced by those in the school, so that the education always advances in and out of doors *pari passu*.

The pupils are thus instructed in all the practical parts of farming, and are also lectured several times a week on the theory of agriculture. They are made acquainted with all the properties of different soils, the manures most applicable, and the crops best adapted to each; points in which most of our practical farmers display great ignorance. They are also made acquainted with all the numerous varieties of cattle, and their qualities, such as early maturity in some breeds, hardihood in others, and have strongly impressed on them that one of the most essential points in farming, is to select the cattle and the crops best adapted to the situation, soil, &c.

The stables, harness-rooms, cow-houses, winter-feeding houses, piggeries, barn, tool-houses, are arranged in the best manner, and the pupils are required to keep them and their contents in the highest order. A respectable and intelligent matron has the superintendance of the dairy, cooking, and cleaning the house, and the charge of the domestic servants.

The formation of this establishment has caused its founders an expenditure of above four thousand pounds; of which about three thousand were raised at its commencement by shares of £25 each, by the noblemen,

gentlemen, and members of the North-west Society. The Grocers' Company, on whose estate it is situated, have been most liberal in their assistance, and have earned a just reward in the improvement of their property, by the valuable example the farm of Templemoyle presents to their tenantry; and it is gratifying to state, that the example is not confined to so limited a circle, but is followed, to a very great extent, by the farmers to a considerable distance.

In sending a pupil to Templemoyle it is necessary to have a nomination from one of the shareholders, or from a subscriber of £2 annually. The annual payment for pupils is £10 a year; and for this trifling sum they are found in board, lodging, and washing, and are educated so as to fit them for land-stewards, directing agents, practical farmers, or surveyors, schoolmasters, or clerks.

From fifteen to seventeen is the age best suited for entrance at Templemoyle, as three years are quite sufficient to qualify a student possessed of ordinary talents and a knowledge of the rudiments of reading and writing, to occupy any of the above situations. If this very short and imperfect sketch of what must and will become a more generally useful institution, as it is more known and appreciated, should lead the reader to wish any fuller information, he may easily be gratified by visiting the agricultural seminary, or by applying to the zealous secretary to the committee, Pitt Shipton, Esq., Londonderry, under cover to Sir R. A. Ferguson, Bart., M.P., who will furnish printed reports containing the history of the rise and progress, the names of the shareholders, the rules and regulations of the society, hours of school and labour, dietary, and a variety of minutiæ, which, though extremely valuable and necessary to be known, yet from their length might prevent the insertion of this outline of the Templemoyle Seminary in those works which, from their circulation, may both increase the utility of the publication, and the knowledge of an institution of which the advantages have been felt and appreciated in the north of Ireland.

N.B.—Upwards of two hundred young men, natives of sixteen different counties in Ireland have passed through, or remain in, the school. Of these between forty and fifty have been placed in different situations, such as land-stewards, agents, school-masters, and clerks, or employed on the ordnance survey. Nearly one hundred are now conducting their own or their father's farms in a manner very superior to that of olden time; and the accounts of those who have been placed from the seminary are such as to gratify the gentlemen who have its interest at heart, and to convince them that the good seed sown is producing an ample and valuable harvest.

Templemoyle, Oct. 14, 1837.

[It gives us unqualified pleasure to lay before our readers the above gratifying account of an institution so eminently calculated to confer lasting benefits upon the country. We have been long strenuous advocates for the establishment of agricultural schools in all parts of Ireland, feeling assured that they would ultimately be the means of breaking down those absurd prejudices which have been hitherto the most insurmountable obstacles with which agricultural improvement had to contend.]—*Editors.*

Farmers' Magazine.

Statistical Tables of the Manufacturing Industry of Massachusetts.

The result of an inquiry into the actual number and amount of the various products of Industry within the state, has been returned by the assessors, in conformity to a law which enjoined this duty upon them. The

facts are returned as they existed on the first day of April, 1837, and have been arranged and published by John P. Bigelow, secretary of the Commonwealth. The report makes an interesting volume of 212 pages, 8vo. A condensed summary, as we find it at the close of the volume, we think will furnish acceptable information to most of our readers.

Articles manufactured or produced.	Value.	Hands employed	Capital invested.
Anchors, Chain Cables, &c.,	$ 114,125	36	$ 80,500
Axes, Scythes, Snaiths, &c.,	325,956	387	196,938
Beer, Bellows, Blacking, Boats and Wherries, Bricks,	152,321	273	55,300
Bonnets, (Straw) and Palm-leaf Hats,	1,902,803		
Books and Stationary, Pocket Books, and School apparatus,	1,048,140	1023	909,800
Boots and Shoes,	14,642,520	39.068	
Brass and Copper,	1,469,354	297	635,800
Britannia and Block Tin,	66,300	59	7000
Brushes, Brooms, and Baskets,	289,512	350	103,095
Buttons, of all kinds,	246,000	358	147,200
Candles, (Spermaceti and Tallow,) and soap,	1,620,730	266	697,300
Candlesticks, Playing Cards, Chocolate, Clocks, Chair Stuff, and Coffee Mills,	66.914	81	29,840
Cards, (Wool,)	254,420	139	148,340
Carriages, Wagons, Sleighs, Harness, &c.,	679,442	945	278,790
Casks and Hoops,	202,832	194	81,250
Chairs and Cabinet Ware,	1,262,121	2011	
Clothing, Neck Stocks, and Suspenders,	2,013,316	3939	780,158
Combs,	268,500	444	
Cordage and Twine,	481,441	439	285,375
Cotton Goods, (Cloths,)	13,056,659	19,754	14,369,719
Cotton Batting, Thread, Warp and Wicking,	169,221	151	78,000
Cotton Printing,	4,183,121	1660	1,539,000
Cutlery,	186,200	193	92,033
Drugs, Medicine, and Dye Stuffs,	371,019	97	98,995
Fishery, (Whale, Cod, and Mackerel,)	7,592,290	20,126	12,484,078
Fur Caps, and other manufactures of Fur,	73,000	100	55,000
Gas,	100,000	40	375,000
Glass,	831,076	647	759,400
Glue,	34,625	18	19,700
Gold and Silver Leaf,	43,000	36	11,200
Gunpowder,	246,357	77	160,800
Hats,	698,086	867	
India Rubber,	18,000	13	10,000

Articles manufactured or produced.	Value.	Hands employed	Capital invested.
Iron Castings, Bar and Rod, &c.,	1,658,670	1311	1,516,025
Jewellery, Silver, and Silver Plate,	325,500	207	161,550
Lead Manufactures, .	201,400	43	6400
Leather, including Morocco,	3,254,416	1798	2,033,423
Looking Glasses, .	165,500	58	61,600
Lumber, Shingles and Staves,	167,778	121	27,750
Machinery, of various kinds,	1,235,390	1399	1,146,775
Muskets, Rifles, Pistols, Swords, &c., . . .	288,800	394	65,943
Nails, Brads, and Tacks,	2,527,095	1095	1,974,000
Oil, (Refined Whale and other Oil,) . .	2,030,321	145	1,133,500
Organs and Piano Fortes,	324,200	239	172,000
Paper, . .	1,544,230	1173	1,167,700
Ploughs, . .	54,561	73	
Saddles, Trunks, and Whips,	351,575	758	109,825
Salt, . .	246,059	708	801,753
Shovels, Spades, Forks and Hoes,	264,709	284	225,523
Silk, . . .	56,150	125	137,000
Spectacles, Starch, Stone and Earthen Ware, . .	35,560	47	20,974
Spirits, . .	1,238,789		
Stone, (Granite, Marble, Slate and Soap Stone,) . .	680,782	1177	209,950
Stoves and Stove Pipe, .	31,000	13	11,815
Sugar, (Refined,) . .	976,454	92	303,653
Snuff and Segars, .	184,601	396	33,300
Tin Ware, . .	394,322	377	
Tools, (Carpenters', Joiners' and Shoemakers',) .	258,531	279	110,807
Types and Stereotypes, .	157,000	215	140,000
Umbrellas, . .	104,500	136	56,500
Upholstery, including Bed-binding, Curtains, Hair and Paper Hangings, . .	55,483	86	13,160
Vessels built in the five years preceding 1st April, 1837, .	6,853,248	2834	
Varnish and Beeswax, .	52,600	8	9000
Window Blinds, Sashes, and Doors	74,166	93	8350
Wire, . .	84,770	53	44,200
Wooden Ware, including Packing Boxes, Rakes, Shoe Pegs, Yokes and Helves, .	174,692	313	26,950
Wool, . .	539,689		2,842,778
Woollen Goods, .	10,399,807	7097	5,770,750
Engravings, Essences, Hosiery. Lamp-black, Mathematical Instruments, Mustard, Razor Straps, Lather Boxes, Pumps, Blocks, &c. &c., .	63,466	117	19,078
Total, . .	$91,765,215	117,352	$54,851,643

The preceding presents the grand total of the returns of the Assessors. It will be perceived that it includes vessels built in the *five* preceding years; all the other articles named having been manufactured or produced within *one* year preceding April last. Deducting the vessels from the above statement, and allowing one-fifth of the value set against them as the proper average for a *single* year, there will remain the sum of *eighty-six millions, two hundred and eighty-two thousand, six hundred and sixteen dollars,* as the value of the articles manufactured or produced by the several specified branches of industry, carried on by the citizens of this State, during the year ending April 1, 1837.

The population of the State, agreeably to the official returns, was on the first day of May 1837, 701,331. That, of each of the 13 largest towns, was as follows: Boston, 80,325; Lowell, 18,010; Salem, 14,985; New Bedford, 14,304; Charlestown, 10,101; Lynn, 9,323; Springfield, 9,234; Taunton, 7,647; Roxbury, 7,493; Worcester, 7,117; Gloucester, 8,822; Cambridge, 7,631. The population of Nantucket was 9,048.

Taking the superficial extent of Massachusetts at 7250 square miles, (for we find it variously stated in geographical books) it appears that the population is verging very closely upon 100 to a square mile, which is allowing nevertheless nearly 6½ acres to each individual. The whole number of sheep in the State was 374,614; the average weight of whose fleeces was 2⅞ lbs. per head. Each labourer, as is evident from the table, produces an amount of manufactured goods, worth more than 700 dollars, and the whole amount is nearly double that of the capital invested. Such statistical returns from each of the States, furnished at intervals of five years, would afford highly interesting data, and if consigned, as in this case, to the care of assessors, the information might be obtained in the most correct, cheap and effectual manner. G.

On a new Property of the Iodide of Silver. *By* H. F. Talbot, Esq., F.R.S.

It is well known that certain metallic oxides and salts have the property of changing their colour when heated, and recovering it again when cold.

The iodide of silver affords an extremely remarkable instance of this, and yet, I believe, the fact is not mentioned by any chemical author. I have n doubt, therefore, that a short notice of it may possess some interest.

Let a sheet of white paper be washed over with a solution of nitrate of silver, and afterwards with a *rather dilute* solution of hydriodate of potash. it will immediately assume a pale yellow tint, owing to the formation of Iodide of silver. The paper may then be dried and laid aside for use.

When the property in question is to be exhibited, the paper is held for some moments before a hot fire, and its colour changes from a pale primrose tint, to a rich gaudy yellow, emulating the sunflower.

Removed from the fire, this bright colour gradually fades away, and in three or four seconds it is entirely gone. It may then be reproduced, and again destroyed as before, and so on for any number of times, for the heat causes no alteration in the substance experimented upon.

When the paper is warm and very yellow, if the finger is pressed upon it and quickly removed, it leaves a print, or impression, of its shape, which is nearly white. The cause of this is, that the finger is a much better conductor of caloric than the atmospheric air, and therefore cools the paper in an instant of time. Any cold substance may be substituted for the finger,

and the effect can be produced at a little distance, without actually touching the paper, merely by the radiation of the cold body. It appears therefore, that this substance, from the peculiar suddenness with which it changes colour, is well adapted for experiments on the radiation and conduction of heat.

If now we throw some drops of ammonia on the paper, it turns white, and if we hold it to the fire we find that it has lost the power of changing colour. Gradually however the ammonia evaporates, and then the alternations of colour occur as before. This seems to prove that the alkali enters into chemical combination with the iodide, and possibly the white substance is the double iodide of silver and ammonia. This opinion is confirmed by observing that potash and soda act in a similar manner, giving rise to *permanent* white compounds unchangeable by heat, which are probably the double iodides of silver and potassium, and silver and sodium.

This is the reason why the paper was directed to be washed with a *rather dilute* solution of hydriodate of potash; for if we use a concentrated solution the resulting tint is white, and the colour of the paper is not changeable by heat.

I have kept some pieces of this prepared paper for a year or two, and find that it still remains as sensitive to heat as ever.

Lond. & Edin. Philos. Mag.

Dr. Lardner's Steam Engine Indicator.

At the last annual meeting of the British Scientific Association, held at Liverpool, a grant of money was placed at the disposal of a committee, to investigate the actual performance of steam vessels with reference to their speed, consumption of fuel, and other circumstances affecting their general efficiency. This investigation arose from a discussion which took place in the mechanical section, in the course of which statements the most conflicting were made, even by practical men, as to the capabilities of steam vessels for extended navigation. In prosecuting their inquiry, the committee have thought it desirable to adopt some method of registering the actual performance of the vessel in a log, which will not be subject to the errors and neglect which have hitherto rendered all steam-logs more or less useless.

With this view Dr. Lardner has attempted to construct a piece of mechanism, which will enable the steam-engine itself to write the journal of its own proceedings. This mechanism is now being constructed, and is intended to be placed in the "Tagus," a large and powerful steam-ship belonging to the Peninsula Steam Navigation Company,—this Company having liberally offered to co-operate with the committee.

The circumstances on which the efficiency of the machinery and the vessel principally depends, and which it is necessary to register, are the following:—

1. The height of the barometer-gauge, which indicates the state of the vacuum produced by the condenser.
2. The height of the steam-gauge which indicates the actual pressure of steam urging the piston.
3. The height of the steam-gauge which indicates the actual pressure of steam in the boiler.

4. The number of revolutions of the paddle-wheels per minute.
5. The depth of water in the boiler.
6. The degree of saltness of the water in the boiler.
7. The rate of the vessel.
8. The draught of the vessel, or her immersion.
9. The direction and force of the wind.
10. The course of the vessel.

The mechanism now being constructed will keep a self-recording register of the first six of these. A provision is, however, made for subsequently adding means of registering the seventh and eighth, should it be found desirable to do so. The consumption of fuel will be easily determined by keeping an account of the quantity of coals delivered into the vessel at each port, making an allowance for what is consumed in the steward's room, kitchen and cabins.

A float is placed on the mercury in the barometer-gauge, from which a rod proceeds, to which the pencil is attached. As the column of mercury rises or falls the pencil receives a corresponding motion, and being pressed against the paper on the cylinder leaves a trace upon it, which measures the extent of the variations of the mercurial column.

The heights of the steam and other gauges are registered in the same manner by other pencils.

The entire apparatus will be enclosed in an octagonal case, about three feet and a half high, and three feet diameter. It will be locked by the agents of the owners when the vessel starts on her voyage, and will not be opened till her return. It will require no other attendance during the voyage than that of winding the clock.

The several pencils will be of different colours, so that their traces may be easily distinguished one from the other. Besides which it will be so arranged that their play may be confined to different parts of the cylinder.

At the end of each voyage the paper will be removed from the cylinder, and replaced by a clean sheet.

If it be thought advisable, the indications of the several curves traced by the pencils may afterwards be translated into the ordinary language of log-books.

It is not improbable that an anemoscope and other apparatus may be contrived, by which the direction of the wind and the course of the vessel may likewise be recorded, at least with as much precision as they are now ascertained by other and less regular expedients.

If this mechanism should succeed in attaining the objects for which it has been contrived, besides its valuable scientific results, it will be productive of great benefit to the proprietors of steam ships, by supplying to them a never-failing check on every one concerned in the management of the vessel. Thus any relaxation of attention, or want of skill, on the part of those in care of the fires, will be indicated by the third pencil. Any neglect in feeding or blowing out the boilers will be indicated by the fifth and sixth pencils. The attention to the state of the condensing apparatus will be shown by the first pencil.

In the event of the temporary suspension of the operation of the machinery for adjustment, or any other cause, the fact of such suspension, its duration, and the time it took place, will be also recorded.

By the connexion of all the indicators with the time-piece, the exact hour, or indeed minute, of each registered circumstance will be recorded.—*Monthly Cron.* Lond. Mech. Mag.

Astronomical and Mathematical Instruments.

The Rev. Dr. Robinson, the celebrated astronomer of Armagh; who left England in September last, to visit the principal observatories of Bavaria, Italy, and France, and also to inform himself of the actual state of the art of astronomical instrument-making in those countries, has arrived in London. The observatories he visited on his route, were those of Manheim, Munich, Milan, Turin, Modena, Florence, and Paris. The workshops he saw in detail, were those of Ertel and Son, of Munich, and Gambey of Paris. The mechanical intelligence of the proprietors of these establishments, before which those of our English instrument makers dwindle into insignificance—the unreserved manner in which they severally communicated the various processes of the art they so pre-eminently cultivate, and the extraordinary beauty and accuracy of their work when finished, have excited in him (than whom no individual is better able to appreciate their value) the greatest admiration. As to the latter—namely, the exquisite workmanship of their instruments, the doctor states that British astronomers will soon have an opportunity of judging for themselves, as two of the meridian circles of Ertel and Son, are in progress; the one for the observatory of Mr. Cooper, M. P., for the county of Sligo; the other for the observatory at Glasgow. The circles of these instruments will be of three feet diameter, divided to two minutes, and, by achromatic micrometer microscopes, magnifying thirty times, these two minutes are subdivided so that an error in reading, amounting to a quarter of a second, can scarcely be committed. Mr. Cooper's instrument will have eight microscopes, and a telescope of nine and a half feet focus, and seven and a half inches aperture. This instrument, ordered only whilst Doctor Robinson was at Munich, will be erected immediately after the meeting of the British Association at Newcastle, in August next, at which Mr. Ertel, as well as Mr. Gambey, will be present. The Glasgow instrument is of the ordinary construction, such as are to be found, made by the same artists, in the observatories of Altona, Konisberg, Dorpat, St. Petersburgh, &c.; four microscopes, however, being substituted in lieu of verniers. The doctor also speaks in the highest terms of the workshops of Mr. Gambey, whose beautiful dividing can alone be compared to that of the Munich artists. Min. Journ.

Lightning Conductors for Ships.

Mr. Editor,—I have read with much interest the scientific papers of your learned correspondent, W. S. Harris, Esq. F. R. S., upon the imperfect construction of the lightning conductors at present in use on board ships, and his comments upon a more perfect application of the results of science, as a defence against danger, which were elucidated in your last number by a diagram.

You will perhaps allow me to suggest, that a perfectly connected conductor may be obtained, according to the laws of electricity ex-

pounded by Mr. Harris, by the employment of copper wire, laid up after the manner of the wire rope lately introduced.

To fit a conductor in this way, it would be simply necessary to make one end fast at the masthead, and lead the other down into the water, by an out-rigger clear of the side. I conceive that the advantages of this plan, over that already proposed, are these: its simplicity of construction; its facility of being shifted when a spar is carried away, or when it is necessary to send a mast down; and that it can also be easily coiled up, and stored in a small compass, when out of use.

I believe the power of a conductor is measured by its extent of surface; and if this be correct, the rope of many wires would have a greater metallic surface than a bar of the same size, be at least as effective for the purpose as the connected lamina proposed by Mr. Harris, to whose consideration I have the pleasure, as a practical seaman, of offering my suggestions.

I am, Sir, &c.

E. Routh, H.C.S.

Jerusalem Coffee House, Nov. 4th, 1827.

Naut. Mag.

Anti Dry-rot.

The following letter has been addressed to the secretary of the Anti Dry-Rot Company, by Mr. Samuel Beazley, the architect.

"Sir:—At the commencement of the year 1836, I surveyed and accurately examined the posts and paling in the Regent's-park, for the purpose of ascertaining the comparative states of those timbers which had been prepared by Kyan's patent, and those which had not been submitted to the process of solution. In my report of that period, I stated that indications of decay were already perceptible in most of the unprepared timbers, both at the bottom of the posts, and in those arris edges and ends of paling which were placed, or had come at all, in contact with the earth, while those timbers which were marked as having passed through the solution, were quite free from any such symptoms. I now beg leave to state, that I have this day, after a lapse of two years and a quarter from my previous survey, again accurately examined several of the same posts and paling, digging away the earth from the foundations for that purpose, and find that the symptoms of decay mentioned in my preceding report as having commenced in the unprepared timber, have so considerably increased, as to have rendered the bottoms of the posts completely rotten, to a depth of from one to two inches, and that, in several instances, fungi have been the consequences of the decay; while I find the prepared timbers which are in the earth sound and in the same state, with the exception of mere discolouration upon the surface, probably arising from the damp state of the earth at the time of its removal. As a farther proof of the difference existing between the unprepared and the prepared timber, we could cut with the greatest ease large pieces from the former with the spade, without using any force, while it required great exertion to chip off very small pieces from the latter." Min. Journ.

Improvement in Window Sashes.

Mr. R. B. Cooper, inventor of the patent spherical stoppers for bottles, jars, &c., the styloxynon, and several other useful articles, has just devised a most ingenious method of superseding the counterpoises and sash lines for windows. The principle will be invaluable in one of its proposed applications, viz: to the windows of stage coaches, omnibusses and railway-carriages; for as there is no *shake*, the present disagreeable and eternal rattle of the windows will be for ever silenced, and conversation rendered audible within the carriages, while carried on in the ordinary tone of voice. As it is probable that a patent will be secured for this simple and effectual contrivance, it would be unfair to enter into any further particulars at this time; suffice it to say, the proposed method is not only superior to, but also actually cheaper than, the old fashioned method of fitting and hanging windows.

W. B.

London, March 12, 1838. Lond. Mech. Mag.

Progress of Physical Science.

Security of Electric Jars from fracture by discharge.

The very frequent destruction of electric jars by perforation, splintering, or fracture, on being discharged at a high intensity, is a source of great annoyance and discouragement to the practical electrician. It is seldom, perhaps, that a battery is discharged after high excitement, without the fracture of one at least of its component jars. An investigation of the cause of this common occurrence has been made by W. Sturgeon, editor of the Annals of Electricity, whose experience in this department of Physics is probably as extensive as that of any person living. Jars are frequently broken by the injudicious practice of placing one knob of the discharger against the side of the jar, while the other knob is made to approach the ball at the top of the jar. It is better to place the jar, when charged, on any good conducting substance, such as a piece of tin foil, or metallic sheet of any kind, and in discharging, to connect this sheet with the ball of the jar.

The fracture, or star, almost always occurs near the top of the lining. From this it was inferred that "the fluid strikes the wire from the upper parts of the lining in almost every discharge from high intensity; and that those jars which are not broken owe their safety to the strength of the glass."

The remedy prescribed, and the results, I give in the author's own words. G.

The electric fluid in the interior of an intensely charged jar indicates the greatest tendency to escape from the top of the lining; and that by the present mode of fitting up jars, an explosion from that part of the lining to the wire probably takes place whenever the jar is discharged through good conducting media, it seemed the most natural method, to *lead* the fluid, as it were, by some good conducting substance by the nearest route, and dispense altogether with the wire and chain that are suspended in the axis of the jar. For this purpose, two slips of tin-foil were secured to the opposite sides of the jar, and reached from the upper edge of the *lining* to the cover on the top; the under part of which was also covered with foil. This latter portion of the foil communicated with the lower extremity of the wire which supports the ball: so that a complete and direct metallic connexion

now existed between the top of the lining and the ball on the top of the jar. Therefore, no explosion in the interior of the jar could possibly take place. The result was, that every jar so fitted up has hitherto withstood the most severe trial. I have, for the last twelve years, employed jars thus protected, without ever breaking one by a discharge: although, during that period, I have discharged a battery of twelve jars some hundreds of times from the most intense electrization. I have called the slips of foil *protectors*: and I am firmly persuaded, that the most extensive battery may, by this means, be perfectly protected.

The next question that naturally presents itself, is, does the insulation continue as perfect in jars thus protected, as in those fitted up in the usual way?

Upon attentive examination, it will be found that the ball and wire of the ordinary jar, must always be electrized equally with the lining with which they are connected by means of the chain; and therefore the insulation from the lining to the coating, in such jars, can only be from the centre of the cover through which the wire passes to the upper edge of the coating: and as the cover is of wood, which is always a partial conductor, it also becomes charged in common with the wire and lining. Therefore, the only perfect insulation is that between the edge of the cover and top of the coating—exactly the same as in jars furnished with protectors.

When jars are cylindrical throughout, no covers need be used. A disk of wood of nearly the same diameter as the interior of the jar, is fixed by wedges of cork at the same height as the top of the lining. This disk is covered with tin foil, and the lower end of the wire carrying the ball is screwed into its centre. In addition to the cork wedges, I usually support the disk by three wooden rods, which rest on the bottom of the jar.

It is not my intention, however, to press the theoretical part of this paper too strongly on the attention of the society; because I am well aware that, unless experiments were made to show that the fluid actually leaps from the upper edge of the lining to the axial wire of ordinarily fitted up jars, it might lead to unnecessary doubts in the minds of those who have paid but little attention to the pursuit of a cause whose effects are the most disheartening that the amateur electrician has to contend with.

I have pointed out what has appeared to me to be the cause of these accidents to jars; and have briefly described the mode of investigation, both mental and experimental, which I pursued: and, whether my theorétical views be considered satisfactory or otherwise, the simple fact, alone, of my not having broken even one jar, thus fitted up, although I have constantly employed them for the last twelve, or more, years, during which, but few have had more extensive practice, may, perhaps, be sufficiently important to induce other electricians to adopt the same mode of protecting *their* jars which, for so long a course of practice, has afforded a complete protection to mine. If I have succeeded in this particular, the principal object for offering this paper to the notice of the Electrical Society will then be accomplished.

Annals of Electricity.

Concomitance of Chemical, and Vital, with Electrical Action.

M. Becquerel has described a most simple apparatus for the development of electricity, consisting merely of a syphon filled with fine sand, and having one leg filled with an acid, the other with an alkaline solution. These fluids meet at the most depending part of the tube, where there is an orifice plugged by a bit of asbestos, which conveys away the compound solution as fast as formed. Wires placed in the two legs

indicate strongly opposed electrical states, and the voltaic current thus produced, continues until all the fluid elements have been united. It is impossible to consider this result without acknowledging the remarkable influence which *capillarity* must have over chemical action, a condition so evident and constant in organized beings.

The late researches of Dr. Faraday have fully proved the identity of electrical with chemical affinity, and that all chemical changes are attended with a disturbance of electric equilibrium. If therefore the changes occasioned by the growth of organized systems are immediately governed by laws similar to those of inorganic matter, we should expect to find that electricity is constantly being developed by them, in the same manner as we, artificially, obtain it by chemical decomposition, or recomposition.

There is no deficiency of evidence that this is the case. During the germination of seeds, the two principal changes are the rejection of carbonic and acetic acids; and it has been recently ascertained that there is at the same time a manifestation of electric action. The seed may indeed be considered an electro-negative system, retaining the bases and rejecting the acids; and it has been accordingly found that grains applied to the negative extremity of a voltaic pile, germinate much more rapidly than those uninfluenced; and that positive electrical influence retards the process. In like manner, slightly alkaline solutions accelerate, and acids delay or altogether check it. In the later periods of vegetable growth, the contemporaneous chemical changes are by no means uniform in character; and it is probably from this cause that artificial currents of electricity do not seem to assist the growth of plants, although atmospheric electricity, which is undoubtedly much connected with the processes of vegetation, appears to accelerate it. That there is constant electric disturbance during the growth of plants, has been fully proved by the experiments of Pouillet; and by many writers, the changes produced by the exhalation of fluid, and the gaseous alterations effected by the leaves, are believed to be the main sources of the constant variations in the electric state of the atmosphere.

The connexion of *capillarity* with electric action has been already noticed; but some other facts may be briefly stated. Various substances having minute, porous structure, possess the power of occasioning the union of oxygen and hydrogen at comparatively low degrees of heat; thus spongy platinum will produce this effect at common temperatures, and charcoal, or porcelain biscuit, at about 300°. It does not seem very clear to what this power is to be attributed; and we are almost equally in the dark regarding the phenomena of endosmose, in which electricity would appear to have some share, the known laws of capillary action not being adequate to explain some of the recently observed facts.*

Many facts corresponding with those to which we just now alluded as having been obtained with regard to the electrical state of different organs of animals, have been remarked in vegetables also. Thus it has been ascertained that wires passed into the pith, and applied to the bark, indicated opposite electrical states; and the same is true of the two extremities of most fruits. Some of the most interesting proofs of the occurrence of electric actions in plants are derived from the experiments of M. Becquerel and Mr. Crosse, on the effect of currents of voltaic electricity of very feeble intensity, in producing the crystallization of

* Cyclopedia of Anatomy, p. 110.

many substances, which, from their insolubility, the chemist has been hitherto unable to procure in that form, but which occur abundantly in vegetables, such as silex, and the carbonate and oxalate of lime. Now, unless we suppose that vital affinity, or action, possesses this remarkable property in common with electricity, a supposition which appears entirely gratuitous, we cannot hesitate to set down the deposit of these salts in a crystalline state in the vegetable tissues, to the electricity developed by other chemical actions going on in the plant.—*W. B. Carpenter.*

Ed. New Phil. Journ.

Stratification of Minerals by Voltaic Electricity.

The following experiments are stated by William Norris, in Sturgeon's Annals of Electricity, to have been performed by Mr. John Leathart of Alston, Cumberland. They are in confirmation of those described by Robert Were Fox, Esq.*

Portions of different rocks were reduced to a fine powder and mingled together with water into a homogeneous mass, of the consistence of soft clay, or mud. After being subjected to the action of a current of electricity from ten days to a fortnight, these compounds were separated into distinct layers or strata of the different rocks which had been mixed together; the line of division between the strata being at right angles to the direction of the current.

A variety of interesting phenomena were observed in the course of these experiments. In one case blue limestone was separated from an equal quantity of argillaceous matter, with which it had been mixed, and was converted into white marble. In another experiment, portions of carboniferous (blue limestone,) siliceous (brown freestone,) and argillaceous (plate or shale) rocks were mixed together. The limestone was collected at the positive, or zinc, end, the plate at the negative, and in the centre the freestone formed a stratum having the appearance of white quartz.

Ibid.

Effects of the Lightning on the Melville Monument, struck on the 14*th of July*, 1837.

The following particulars are curious:—The door which leads to the outer plinth at the top of the monument, immediately below the statue, fell to the bottom the instant the monument was struck; but, upon being inspected about three-quarters of an hour afterwards, there did not appear any of the usual effects of the electric fluid upon the ironwork or otherwise. The key of the door below, which leads to the top of the monument, was obtained, and upon entering it no appearance of damage could be discovered. On reaching the top of the stair, however, it was found that the stones which form the apex of the central part of the monument, upon which the stair rests, and which are perforated from the cupola to the bottom, on purpose to admit the conductor, were dislodged. The conductor was a chain, part of which was discovered still hanging at the top of the cupola, immediately underneath the statue. The rest of the chain was not to be seen, but upon descending to the bottom, and looking underneath the centre, upon which the stair is fixed, the chain was found in a heap, quite hot, and having a white calcined appearance. It would appear, therefore, that the door had

* Journal Franklin Institute, page 251, Vol. XXI.

not been struck by the lightning, but had been forced out by the concussion, arising from the aperture, which leads down through the centre of the stair from the top of the monument, being too small to admit the shock; which circumstance, causing a momentary interruption, had had the effect of dislodging the stones at that place for a couple of yards, wresting the door from the hinges, and breaking the chain. From all these circumstances it would appear that the conductor saved the monument.—(*Caledonian Mercury.*)

Archi. Mag.

Mechanics' Register.

Astonishing facts relative to a former Organic World.

"Dr. Buckland now proceeds to the most important and popular branch of his subject—to give a description of the most interesting fossil organic remains, and to show that the extinct species of plants and animals which formerly occupied our planet, display, even in their fragments and relics, the same marks of wisdom and design which have been universally recognized in the existing species of organized beings.

"After giving some account of the supposed cases of fossil human bones, and establishing the remarkable fact of the 'total absence of any vestiges of the human species throughout the entire series of geological formations," our author passes to the general history of fossil organic remains:—

"'It is marvellous that mankind should have gone on for so many centuries in ignorance of the fact, which is now so fully demonstrated, that no small part of the present surface of the earth is derived from the remains of animals that constituted the population of ancient seas. Many extensive plains and massive mountains, form, as it were, the great charnel-houses of preceding generations, in which the petrified exuviæ of extinct races of animals and vegetables are piled into stupendous monuments of the operations of life and death, during almost immeasurable periods of past time. "At the sight of a spectacle," says Cuvier, "so imposing, so terrible as that of the wreck of animal life, forming almost the entire soil on which we tread, it is difficult to restrain the imagination from hazarding some conjectures as to the cause by which such great effects have been produced." The deeper we descend into the strata of the earth, the higher do we ascend into the archæological history of past ages of creation. We find successive stages marked by varying forms of animal and vegetable life, and these generally differ more and more widely from existing species as we go further downwards into the receptacles of the wreck of more ancient creations. * * * *

'Besides the more obvious remains of testacea and of larger animals, minute examination discloses, occasionally, prodigious accumulations of microscopic shells that surprise us no less by their abundance than their extreme minuteness; the mode in which they are sometimes crowded together may be estimated from the fact that Soldani collected from less than an ounce and a half of stone, found in the hills of Casciana, in Tuscany, 10,454 microscopic chambered shells. * * * Of several species of these shells, four or five hundred weigh but a single grain; of one species he calculates that a thousand individuals would scarcely weigh one grain.'

"Extraordinary as these phenomena must appear, the recent discoveries of Ehrenberg, made since the publication of Dr. Buckland's work, are still more marvellous and instructive. This eminent naturalist, whose discoveries respecting the existing infusorial animals we have already noticed, has dis-

covered fossil *animalcules*, or infusorial organic remains; and not only has he discovered their existence by the microscope, but he has found that they form extensive strata of tripoli, or poleschiefer (polishing slate,) at Franzenbad, in Bohemia—a substance supposed to have been formed from sediments of fine volcanic ashes in quiet waters. These animals belong to the genus Bacillaria, and inhabit siliceous shells, the accumulation of which form the strata of polishing slate. The size of a single individual of these animalcules is about 1.288th of a line, or the 3400th part of an inch. In the polishing slate from Bilin, in which there seems no extraneous matter, and no vacuities, a cubic line contains, in round numbers, 23,000,000 of these animals, and a cubic inch 41,000,000,000 of them. The weight of a cubic inch of the tripoli which contains them is 270 grains. Hence there are 187,000,000 of these animalcules in a single grain; or the silicious coat of one of these animals is the 18,000,000th part of a grain!

"Since this strange discovery was made, Mr. Ehrenberg has detected the same fossil animals in the semiopal, which is found along with the polishing slate in the tertiary strata of Bilin, in the chalk flints, and even in the semiopal or noble opal of the porphyritic rocks. What a singular application does this fact exhibit of the remains of the ancient world! While our habitations are sometimes built of the solid aggregate of millions of microscopic shells—while, as we have seen, our apartments are heated and lighted with the wreck of mighty forests that covered the primeval valleys—the chaplet of beauty shines with the very sepulchres in which millions of animals are entombed! Thus has death become the handmaid and the ornament of life. Would that it were also its instructor and guide!"—*Ed. Review.*

Min. Jour.

LUNAR OCCULTATIONS FOR PHILADELPHIA, SEPTEMBER 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
1	13	54	Im. χ Capricorni	5,6	149	189
1	14	47	Em.		271	317
5	12	0	Im. (189) Piscium	,6,	169	139
5	12	53	Em.		270	254
8	12	20	Im. 9 Tauri	,6,	161	104
8	13	6	Em.		256	200
8	16	51	Im. *b* Pleiadum	,5,6,	155	175
8	17	52	Em.		251	295
8	17	22	Im. *d* Pleiadum	,5,	91	125
8	18	38	Em.		308	359
8	18	5	Im. σ Tauri	,3,	104	148
8	19	23	Em.		291	347
11	12	6	Im. *c* Aurigae	,6,	112	64
11	12	59	Em.		261	208
11	14	7	Im 54 Aurigae	,6,	153	95
11	14	44	Em.		221	162
18	3	12	25.4s Begin.* Solar Eclipse		235	278
18	4	30	18.7s Begin. Ring			
18	4	33	44.7s nearest approach of Centres			
18	4	35	10.7 end of Ring			
18	5	44	38.0 end of Solar Eclipse		56	107

*See August Number for 1837 of this Journal.

House Painting.

A very simple method has lately been adopted to render the surface of paint perfectly smooth, and eradicate the brush marks. It is done by a small roller covered with a cloth, or felt, eight inches long and two inches in diameter, worked in an iron frame on pivots, similar to the common garden roller. The flatting coat by this method is made beautifully even, and looks exceedingly well. (*Athenæum*, Nov. 4, 1837.) Archit. Mag.

Harefield Copper and Zinc Works.

The great novelty in these works seems to be the fine process of manufacturing sheet zinc, which the company have been the first to bring to perfection in this country. The use of plates of malleable zinc is now becoming very general; and seems, indeed, to be universally introduced in the modern system of building. It is fast taking the place of copper in many instances, and of lead and tin in many more, being so much cheaper and lighter than the two former. Thus, copper is about 102*l.* per ton: sheet zinc about 25*l.* per ton. Lead is the same price as the zinc, but requires to be four times thicker when laid down, which, of course, makes it three-fourths dearer.—*Monthly Repository.* Ibid.

Meteorological Observations for March, 1838.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	16	32	30.96	30.00	W.	Moderate.		Clear—do.
	2	21	35	29.85	29.96	NE.	do.		Partially cloudy—do. do.
☾	3	20	34	30.15	30.20	N.	do.		Partially cloudy—cloudy.
	4	23	39	29.76	20	NW.	do.		Clear—do.
	5	32	36	85	29.45	E.SE.	do.	.90	Snow—rain
	6	36	49	65	76	W.	do.		Clear—do.
	7	34	38	80	80	E.	do.		Snow—drizzle.
	8	33	36	80	65	E.	do	.55	Drizzle—rain.
	9	33	49	90	90	W.	do.		Cloudy—do.
☉	10	35	48	30.15	30.15	W.	do.		Clear—do.
	11	33	48	00	29.87	W.	do.		Clear—lightly cloudy.
	12	37	33	29.80	90	W.	do		Clear—flying clouds.
	13	32	54	30.05	30.10	W.S.	do.		Clear—do.
	14	32	54	00	00	NW.	do.		Clear—cloudy.
	15	40	58	29.85	29.80	W.	do.		Cloudy—clear.
	16	42	56	80	80	N.	Blustering.		Cloudy—cloudy.
	17	36	43	78	75	E.	do.	1.25	Rain—rain and snow.
	18	32	34	55	56	NE.	do	.05	Snow—do.
☽	19	32	42	55	55	W.	Moderate.		Clear—do.
	20	37	56	56	56	W.	do		Clear—do.
	21	38	54	70	90	NW.NE.	do.		Cloudy—lightly do.
	22	36	43	30.10	30.10	E.	do.		Cloudy—do.
	23	39	46	20	15	W.SW.	do-		Cloudy—do.
	24	37	67	29.93	29.90	SW.	do.		Cloudy—lightly do.
⊗	25	38	50	30.20	30.24	W.N.	do.		Cloudy—clear.
	26	38	68	05	05	W.	do-		Clear—clear
	27	39	48	05	29.85	E.	do·	.05	Lightly cloudy—shower.
	28	32	42	00	30.05	E.	do.		Cloudy—do.
	29	36	48	29.45	29.40	W.	Blustering	.09	Rain—flying clouds.
	30	36	56	50	50	W.	Moderate.		Clear—do.
	31	40	57	60	60	SW.	do.		Cloudy—clear.
	Mean	33.71	47.51	29.86	29.88			2.87	

	Thermometer.	Barometer.
Maximum height during the month.	68.00 on 26th.	30.75 on 23rd,
Minimum do.	16.00 on 1st.	29.40 on 29th.
Mean do.	40.61	29.87

JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

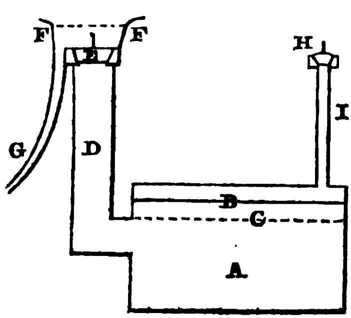
MECHANICS' REGISTER.

AUGUST, 1838.

Practical and Theoretical Mechanics and Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Suggestions relating to a mode of constructing Steam Boilers to guard against Explosions. By Erskine Hazard, C. E.



The numerous disasters which are occurring from the bursting of steam boilers, render it important that every plan should be suggested which has the least chance of remedying the evil. I therefore propose the following for the consideration of the Institute. A is a steam boiler, of which B is the high water line, and C the line below which the water is never intended to sink. D is a pipe introduced into the boiler, so that the upper edge of the entrance into it may be just at the lowest water line, and having the valve E like the common safety valve. From this construction it is evident that when steam forms in the boiler, a column of water will be forced up into the pipe D, the height of which, together with the weight of the valve E, must be adjusted so as to balance the highest pressure at which the engine is intended to work. Should the steam rise above this pressure, the water will raise the valve E, and escape into the receiver F F, from which it may be conducted through the pipe G, to a little water wheel, which will ring a bell near the engineer, and thus give him notice of the fact, when by raising the usual safety valve H, he may relieve the boiler by letting off the steam. Should the water sink too low in the boiler, the steam will immediately rush into the pipe D, and displace the column of water in it—the valve E, without this column of water, will not retain the steam, which will then escape, and by its noise give notice that there is a deficiency of water in the boiler. The pipe D may be of such large dimensions as to let off without danger the whole steam from the boiler, and thus effectually pre-

vent explosions. Small pipes, with valves, like D, may be introduced at different heights in the place of gauge cocks. The higher these pipes are carried, of course the less weight will be necessary in the valves, as the columns of water in them form a portion of the counter balance to the steam.

In sea vessels, the boilers should be divided, by wooden partitions, into small compartments, to prevent portions of the boiler being exposed dry to the fire even when there is sufficient water in the boiler, by the vessel being kept on an uneven keel by a long wave.

The above principle is applicable to boilers for heating water connected with our water works, where the pressure of the head is constantly upon them. Suppose A to be one of these boilers in a situation where the pressure of the water is equal to 30 lbs., with the pipe I, inserted at the highest point of the boiler. If this pipe were carried up about 60 feet, it would require no valve on top to close it, as the column of water would balance the pressure; but there are few situations where it would be convenient to carry a pipe so high. Make the pipe 20 feet high, and the column of water would equal 10 lbs., and by adding a valve of 20 lbs., you would resist the pressure of the water. But any steam forming in the boiler, would displace the column of water, and leave only the 20 lbs. pressure in the valve to resist the passage of the steam, which would be urged forward by the 30 lbs. pressure of the water works, and would continue to escape until the column of water again rose to the valve and equalized the pressure.

June 22d, 1838.

Physical Science.

To the Committee on Publication of the Franklin Institute.

Experiments on Spontaneous Evaporation. By James P. Espy.

On the 2nd April 1831, I hung up two porous earthen pots, which I kept constantly filled with water, one in the shade, and the other in the sun. The superficies of each was thirty square inches. I supplied these, from day to day, from two vials each containing 12 ounces of water, avoirdupois.

The pot in the sun evaporated,				The pot in the shade evaporated,			
April 2nd	to April 8th	12	oz.	April 2nd	to April 10th	12	oz.
8	17	12	"	10	" 20	12	"
17	27	12	"	20	" 30	12	"
27	May 5	12	"	30	May 10	12	"
May 5	" 12	12	"	May 10	" 20	12	"
12	" 18	12	"	20	" 27	12	"
18	" 24	12	"	27	June 3	12	"
24	" 29	12	"	June 3rd	" 12	12	"
29	June 4	12	"	12	" 26	12	"
June 4	" 10	12	"	26	July 6	12	"
10	" 19	12	"	July 6	" 15	12	"
19	" 26	12	"	15	" 24	12	"
				24	Aug. 3	12	"

On the same day, April 2nd, 1831, I also placed three tumblers of glass in the sun, one of them, in the open air, kept filled with water, and two sunk in the ground up to the rim, one of them was kept filled with water, the other with wet earth. From the 2nd of April to the 19th of May the tumbler in the open air had evaporated 21½ ounces, and each of those sunk in the earth 11 ounces, avoirdupois. On the 12th of June the sunk tumbler with water evaporated 21½ ounces, and on the 13th June, that is, one day longer, the tumbler with wet earth had evaporated 21½ ounces from the 2nd of April. The experiments with the two sunk tumblers were soon after discontinued in consequence of an accident—but the tumbler in the open air had evaporated 21½ ounces more on the 18th of June, and 21⅓ ounces more on the 24th of July. The area of the interior of the rim of each of these tumblers was 12 square inches.

It will be seen from these experiments, that about 2½ times as much evaporated from a square inch of surface of the porous pot in the sun as from the sunk tumblers in the sun, which can be accounted for from the readiness with which the vapour, as soon as formed, would be removed from the surface of the porous pot; for I have demonstrated since, by experiment, that if the film of vapour is not removed from the surface of a humid body, by the motion of the air, evaporation ceases; as air I find is not pervious to the vapour of water to any considerable extent.

From these experiments it may be calculated how much is evaporated from a humid surface of earth in a given time, at the season of the year in which the experiments were made, and unless I have made a mistake in a rough calculation, the reader will find that about 2.70 inches, in perpendicular depth were evaporated from each square inch of moist earth from the second of April to the 4th June, and from 2nd April to the 12th of June, 3.04 inches.

Wishing to know how much more rapidly evaporation goes on when the vapour is rapidly removed from the humid surface, I took two towels of 8000 square inches area each, or counting both surfaces 16000 square inches. I made these towels wet, and hung one of them up in a close room by two of its corners; and in the same room I swung the other towel about, continuing the experiment for 8 minutes, for two successive experiments.

Experiment 1st,	evaporation from	one at rest	119	grains.
"	"	one in motion	1153	"
Experiment 2nd.	"	one at rest	104	"
"	"	one in motion	1172	"

The temperature of the air at the beginning of first experiment was 74° and dew point 53.5°; at the end of 2nd experiment, temperature 74 and dew point 58.4.

A third experiment was made by blowing upon one of the towels with a fan, instead of agitating it in my hands, and the following is the result of the operation continued for eight minutes.

Experiment 3rd,	towel at rest, lost	107	grains.
"	towel fanned "	669	"

Temperature at beginning of experiment 75°, dew point 58°.

Temperature at the end of experiment 75.6, dew point 61°.

(Copied from my original minutes this 7th July, 1838, Philadelphia.)

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN OCTOBER, 1837.
With Remarks and Exemplifications by the Editor.

312. For an improvement in the *Horse Power;* Henry Smith, Bethel, Miami county, Ohio, October 6.

There is but little of novelty in this power, the only things claimed being mere matters of arrangement, which may probably present some advantages. The horse power is to be a portable one, having an axle to receive wheels like cart wheels, and a tongue by which it may be drawn from place to place. A main horizontal wheel is to be turned by means of a lever, or sweep, which, by gearing, is to give motion to a line shaft, under the feet of the horse, as in numerous other machines. The claims are to "the method of hanging the master wheel upon a spindle which runs in a standard, and the rim of the wheel supported by rollers beneath; the method of constructing and fastening the arms of the master wheel by stirrups which support the lever to draw by, and the method of constructing the movable truck."

313. For a machine for *Boring and Mortising Wheel Hubs, and other articles;* James Tompkins, Conesville, Schoharie county, New York, October 6.

The claims made under this patent are very indefinite in their character, the principal dependance being upon the general arrangement and combination of the respective parts, which do not admit of ready verbal explanation.

314. For an improvement in the construction of *Clamps used by Shoemakers, Harness makers, and others*, for holding leather; Richard Evans, Mansfield, Warren county, New Jersey, October 6.

This clamp is represented in the drawing as made to be held between the knees, in the manner of those used by shoemakers, but it may be fixed upon a bench, in the manner of the harness-makers' clamp. Its peculiarity consists in the method of holding the jaws together, the claims being to "the modes described of closing, holding, and liberating, the clamps used by shoemakers and others, by having a notched piece of metal, or joint piece, fastened to one jaw, and sliding through the other, with a sliding catch and a thumb piece, operating substantially in the manner shown."

315. For an improvement in the *Railway Oven for Baking Bread, &c.;* Sewall Short, Nantucket, county of Nantucket, Massachusetts; patent dated September 6.

A brick oven is to be constructed, the upper part of which is a semicylindrical arch, within which there is a sheet iron oven, adapted to the arch, and having a flat bottom; this iron oven stands about three inches, on its top and sides, from the brick arch, the space forming a flue for the passage of flame and smoke; below the iron oven is a space also for the flame and heat passing from the grate containing the fuel, and thence under, and then around, the oven. The fuel is contained in a cylindrical grate, composed of iron bars, which is received in a recess in the brick work near the lower side of the oven, which recess opens into the space under the iron oven. The flame and smoke from the grate pass under the iron oven, then

up its far side, over the arch and down its near side, whence it escapes into a smoke pipe situated a little above the cylindrical grate; the cylindrical grate is made to revolve on axes at its ends.

The ends of the iron oven are closed, but there is a longitudinal opening in each, near the bottom, and nearly as wide as the oven; and through these openings the articles to be baked are passed into, and removed from, the oven. For this purpose a flat wire grating, mounted on a flat car, adapted to the openings, has the articles to be baked placed upon it, and is then run into the oven, there being at each end a frame, constituting a railway, upon which the wire grating, or flat car, is run in at one end, and out at the other, one car being removed, and another run in, as the baking is completed.

The claims made are to "the combination of the revolving grate, and the arrangement of the flues, with an oven constructed substantially as above described; and the combination of the railway and carriages with the ovens, as above described."

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316. For an improvement in the *Galley, or Cooking Stove, for Ships of War, &c.;* James Barron, Commodore U. S. Navy, city of Philadelphia, October 6.

The claims made are to "the manner of arranging the boilers in a ship's galley, or cooking stove, so that one of their sides shall be directly exposed to the action of the fire, as described. Also the placing of side ovens for baking, which receive their heat from the outer plates of the galley, as set forth. Likewise the movable grate to enable me to substitute wood for coal. Likewise the employment of a drawer, or drawers, in the manner and for the purpose explained; and also the construction and application of the canopy."

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317. For improvements in the *Hemp and Flax Dressing Machine;* William and Robert Brittain, Lambertsville, Hunterdon county, New Jersey, October 12.

This machine consists mainly of several successive pairs of rollers, placed one above the other, across a horizontal frame; these rollers have plates of iron along them, at suitable distances, formed into teeth, and are geared at their ends in such a way that the respective rows of teeth shall present themselves in the middle of the spaces of the corresponding rollers. The upper are borne down upon the lower rollers by adjustable springs. At the delivering end of the series of rollers one or two of the upper ones receive a quicker motion than the others, and those below them are to be simple rollers, without teeth, the object of which is to loosen and discharge the shives the more effectually from the hemp or flax.

"We do not claim the general arrangement of the rollers, or the insertion of metallic plates along them, these having been before used; but what we do claim as our invention in the above described machine, is the employment of one or more smooth rollers, the antagonists of which are furnished with metallic plates, and are so geared as to run with a different rate of speed, so that the material between them may be operated upon by a rubbing motion, as herein set forth. We also claim the use and application of the spring bars, for the uses and purposes herein set forth, and in the manner described."

318. For a *Press for Tobacco, and other substances;* James H. Washington, Baltimore, October 12.

The patentee says that the principle of his press "consists in the use of a right and left screw on one shaft, or stem, in combination with a cross head and piston peculiarly connected, by which two or more compressions are produced at one operation, and at each end of the machine, by the alternate action and reaction of the screw, or by a reverse action of the driving power." The claim made is to the peculiar manner of connecting the cross heads and pistons; that is to say, the mode of connecting the cross head to the piston, by which the piston can press on both sides; the cross heads being connected to the shanks of the pistons on the outside of the moulds, substantially as described."

It is not pretended that a right and left handed screw upon opposite ends of the same shaft, applied to a press, is new; but it is the adaptation of the press to its intended purpose of pressing tobacco, principally, which appears to be considered as constituting the claim. The screw is placed within a frame so as to operate horizontally, and by turning it the lumps at one end are pressed, while those at the other are relieved and renewed.

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319. For improvements in the *Machine for Measuring Fluids;* James Bogardus, City of New York, October 12.

The main object of this apparatus is its application as a gas meter, but its employment for the measuring of liquids is also contemplated. Its construction is made known by the aid of fourteen drawings; and without them, the claims would not afford any correct idea of the nature of the instrument.

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320. For improvements in the method of *Ascending and Descending Inclined Planes on Railroads;* Elisha F. Aldrick, city of New York, October 12.

We cannot discover any thing in the construction of the proposed apparatus, which will redeem it from the defects found in analogous contrivances which have preceded it. The claims made are to "the peculiar and various modes of constructing the raised rails, and wheels to fit the same. Also the method, or methods, of keeping the water level in the boilers of the locomotive. Likewise the mode of working the brakes, and the placing the cranks or connexions between the large and small wheels and the bearings, outside of the small wheels."

The main feature of the machine is old, and it is only to those peculiarities of arrangement made by the patentee, that any valid claim can exist. To ascend and descend inclined planes, rack rails are to be elevated on each side of the track, and upon these, cogwheels, or pinions, upon the wheel axles, either inside or outside of their bearings, are to run, the rack rails being elevated, not only to raise the driving wheels from the track, but to a sufficient height to keep the water in the boilers level, the small wheels still acting upon the main track. The plan of drawing the brakes against the wheels to check the motion, is, to force upon a lever which is affixed to a shaft, having a chain, or chains, attached to it, which draw up on the brakes when the shaft is turned.

The sustaining the load upon a rack rail, upon which pinions rest, may appear feasible to the inexperienced, but a little reflection will show to any one practically acquainted with mechanics, that the enormous friction upon

cogs thus loaded, and bottoming, would suffice to condemn the plan, were there no other objections to it. The mode proposed of causing the locomotive to take its place on the rack rail, as well as the other devices pointed out, do not bespeak the hand of an experienced engineer, and we are apprehensive that the proposed improvements will be found to be much more imaginary than real.

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321. For improvements in the *Machine for Cleaning Wool from Burs and other foreign substances;* Josiah Walcott, Jr., and Charles W. Brown, Roxbury, Norfolk county, Massachusetts, October 13.

The wool, with the burs in it, is to be fed by means of a feeding apron on to a card cylinder, like those used in the ordinary carding machine; when distributed upon this cylinder, as it passes down in its revolution, it encounters another cylinder, called a fly, from its rapid motion, and which is to clear out the burs from the wool. This fly cylinder has metallic plates about an inch wide, extending from end to end, at right angles to, or radially with, the cylinder. The outer edges of these plates are toothed, somewhat in the manner of a saw, the teeth coming nearly into contact with those of the card cylinders. The patentees say that "the fly in its rapid revolution in a contrary direction, strikes the wool with the comb plates, and knocks or combs the burs and other dirty substances entirely from it; and by this operation, it is most thoroughly cleansed without receiving the least damage in its fibre, or otherwise, nor do the cards receive any injury." "What we claim as our invention, and desire to secure by letters patent, is the combination of the fly or picking cylinder, with the porcupine or card cylinder, as above described."

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322. For *Removing the Bitterings from Salt Boilers*; David Dear, Salina, Onondago county, New York, October 18. (See Specification.)

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323. For an improvement in the *Cooking Stove;* Elijah Skinner, Sandwich, Strafford county, New Hampshire, October 18.

The manner of conducting the flues, and of connecting this stove with a brick hearth and fire place, constitute the principal points claimed. It does not, however, appear to possess any novel feature worthy of special notice, and we therefore leave it to take its proper standing in the stove family, according to its disposition and qualities, as these may be developed by experience.

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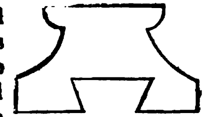
324. For *Constructing and Fastening the Iron Rails on the Timber of Railways*; Peter Henry Dreyer, city of New York, October 18.



The iron rail plate is to be made with a dovetail groove on the under side, running its whole length, its cross section being as in the margin. These rails are to lay upon string pieces, to which they are to be fastened by iron bolts passing through the string pieces, beneath which they are to be key-wedged. The head of the bolt is dovetailed, to fit the groove, but by turning it one quarter round, the rail may be lifted, the flat side of the bolt clearing it of the groove. At their ends the rails are held by resting on plates secured to string pieces, and having dovetail projections upon them which pass into the ends of the rails. The claim is to "the dovetail grooved rails, dovetailed bolts and plates, and grooved

wedge plates, applied to the construction of railways; by which means, and the wedge key, the iron dovetail grooved rail is perfectly and most substantially secured on the string piece, or timber, of the railroad."

325. For improved *Fire Apparatus for Cooking, and Warming Apartments*; Daniel Stephens, Kirtland, Geauga county, Ohio, October 18.

In this apparatus the fire is to be made in the middle of the room, in a fire place, over which there is an inverted funnel attached to a stove pipe, and suspended from the ceiling, the pipe leading to a chimney. There are several peculiar contrivances which are made the subjects of claim, but which it is not worth while to describe, as they are adapted to this apparatus particularly, and will share its fate, of which we are apprehensive that longevity will not form any part.

326. For improvements in *Gun Carriages for Ships of War*; John Bubier, Marblehead, Massachusetts, October 20.

"The nature of my invention consists in providing the gun carriages with a centre slide and train wheel. The former for keeping the gun always in a line with the port, and giving more precision to the range of the shot by a steady and uniform recoil of the piece; and the latter to facilitate the movement, or training, of the gun upon the object."

The carriage is made, generally, in the usual manner, but it has grooved cleats fixed on the insides of each of its cheeks, resting on the forward and after axles, which grooves receive a slide that is tongued to fit them exactly. The slide has at its forward end, eye plates to receive a fighting bolt, which confines it, by a start, to the ship's sides; the start being placed in the quick work exactly in the centre of the port, and on a level with the slide, allowing it to play back and forth between the transum and the axles. The gun thus connected, never interferes with the port frame, but must always come out in the centre of the port. The train wheel, with its vertical shaft and screw, is placed at the rear of the gun carriage, the train wheel standing at right angles with the direction of the gun; the shaft and screw allowing the hind wheels, or trucks, to be raised from the deck, so that the weight may rest on the train wheel, and the gun be moved and trained at pleasure, without the use of crows, or handspikes, articles so destructive to the wood work of the vessel.

"What I claim as my invention, and desire to secure by letters patent, is the addition of the centre slide, and train wheel, to the gun carriages now in use on board of ships of war."

To nautical men it belongs to give a valid opinion of an invention like that above described, and possibly those who are competent to decide the question may urge some fatal objection to the plan. Of nautical matters we know nothing practically, and have not a right, therefore, to express with any confidence, the very favourable opinion which we entertain of Lieutenant Bubier's invention.

327. For an improved *Door Spring for shutting Doors and Gates*; Ithiel S. Richardson, city of Boston, Massachusetts, October 20.

On the door frame, above the door, and towards its back edge, is affixed a frame which supports two wheels, or pulleys, grooved on their edges, and turning horizontally upon centre pins. A stud, or arm, is fixed on the door,

and projects above it, having a chain attached to it, the other end of which is fastened to the hindmost of the two pulleys, so that when the door is opened the chain will draw upon the pulley and cause it to turn; an excentric, or cam, is fixed on the axis of this pulley, and has attached to it one end of a second chain, the other end being fastened to a spiral spring by which it is drawn to it; the second pulley serves, by means of its groove, to conduct the chain from the cam to the spring. The claim is to "the application of a cam, or eccentric wheel, to a spring for shutting doors and gates, in the manner described, by which the power of the spring acting on the door, is decreased as the door opens; and which allows the spring to act with the greatest force when the door is nearest shut."

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328. For an improved mode of *Attaching Glass Knobs to Metallic Sockets;* Enoch and G. W. Robinson, city of Boston, Massachusetts, October 20.

The glass knobs for door handles, or other purposes, are to have necks which will fit into the metal socket to which they are to be attached. Around the neck is to be formed a hollow, or groove, to receive a portion of the melted metal by which the two are to be attached together. The neck and socket are to fit closely where they come together, but towards the lower part of the socket it must be enlarged to receive the metal which is to be poured in; a hole is to be drilled through the socket, opposite the groove in the knob. When thus prepared, the two are to be heated so as to adapt them to the receiving of the metal without danger to the glass; tin, or other fused metal, is then to be poured in at the hole drilled for that purpose. The claim is to "the fastening of the metal socket and the glass knobs, by means of melted metal introduced between them; and the adaptation of the forms of the knobs and sockets to effect that purpose, in any manner similar in principle to that described."

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329. For improvements in the mode of *Measuring, Draughting, and Cutting Garments;* Wm. W. Allen, city of Philadelphia, October 23.

The patentee makes eight distinct claims to his improved apparatus and mode of procedure. A rod, or standard, about six feet high, is to be erected upon a suitable platform, and upon this standard there are to be various vertical and horizontal slides, some of which are furnished with measuring tapes. This instrument operates in part like that described in our last number, p. 43, for measuring for pantaloons only, but this is applied to the difficult art of cutting coats; of its merits we give no opinion, the subject being one in which we might manifest much ignorance certainly and but little knowledge.

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330. For a *Brick Mould;* Benjamin N. Brown, city of Alexandria, D. C., October 23.

This mould is particularly adapted to be used with the machine for making bricks from dry clay, patented by Nathan Sawyer, on the 18th of April, 1835. The general form of the mould is the same with that described in the notice of Mr. Sawyer's patent, having the upper edges hollowed in the manner, and with the view, there set forth. In the present instance the mould is made double, consisting of one metallic box sliding within another, the object of which is to cause the clay to be condensed sufficiently in the

middle of the brick, by lessening the friction against the sides of the moulds; how this construction effects the purpose intended, may be more readily imagined than explained. The claim is to the double mould as described.

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331. For improvements in the *Double Acting Force Pump;* Dudley L. Farnam, city of New York, October 23.

Claim. "What I claim as constituting my invention, are the combination and employment of two double acting cylinders in fire engines, ship's pumps, and others, where the raising and forcing of a large quantity is desired; the apparatus being arranged and constructed substantially in the way set forth, and combined with the valve seat plates, with their valves attached, as described, above and below the water chamber; whether the two cylinders, or only one be employed; and this mode of affixing the valve seats I claim, whether the said cylinders be double or single acting."

The valve seats are attached to the box, or chamber, on which the cylinders rest, by means of screw bolts, the removal of which liberates the valve plates, and gives immediate access to the valves for any purpose for which it may be required. The cylinders, it will be seen by the foregoing claim, are to be double acting, operating like the double acting steam engine, or rather like other double acting pumps, which are well known, but not previously used, it is believed, as connected or combined in the present apparatus.

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332. For an improved *Composition of Matter to be used as Paint for Houses;* William Cox, Dayton, Montgomery county, Ohio, October 23.

This composition of matter is no doubt new, and it is about as heterogenous as could well have been desired; it is intended, it seems, to be used principally in painting brick houses; the following is the recipe:

For 33 gallons of paint, take one bushel of unslaked lime, one and a half gallons strong vinegar, five pounds of alum, two pounds of pearlash, five quarts of common salt, half a pound of salt petre, half a pound of borax; mix them in twenty-six gallons of hot water, and when dissolved it is ready for use. It is to be made of any desired colour by the addition of red lead, spanish brown, yellow ochre, or other pigment. The claim is to the combination of the above ingredients.

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333. For a *Machine for making Bricks;* Gaylord D. Harper, Franklinville, Catteragus county, New York, October 23.

The claims made are to the combination and arrangement of the machine; to certain channels for conveying water to moisten the clay, and keep the bars wet; and to valves and apertures in the pistons. The issuing of the patent shows that the description of it was understood in the office when examined; it, however, is obscure, and the drawings not of a kind to lend the desired aid; we are not disposed to study the thing, as it would require more attention than it appears to merit, as it is not of very general interest.

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334. For an improvement in the *Clasp and Lock for Mail Bags;* Henry C. Jones, Newark, New Jersey, October 23.

The claims are to the particular construction of a bolt for securing the clasp, in its combination therewith; to the arrangement of the springs, and spring guard; and to certain cams for raising the spring guard and throwing

back the bolt, as combined together. There appears to be too much complexity in the thing, and too much liability to derangement to render it suitable for mail bags; nor does it present any thing special, and worthy of particular notice.

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335. For an improved *Manufacture of Colouring Matter*; Henry Stephens, of St. Mary La Bonne, London, Great Britain, October 28.

This colouring matter consists principally of a solution of Prussian blue, and is extensively employed in the preparation of Stephens' blue writing ink. Since the date of the foregoing patent, it has been surrendered under an amended specification, a copy of which we intend to furnish in the next number of this journal.

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336. For an improvement in the *Circular Railway and Car*; James Rowe, Triana, Madison county, Alabama, October 28.

The patentee says that he has invented "a new and useful circular railway and car for transporting passengers, burdens, and for all other useful purposes to which said improvement may be applied."

To judge of the contents of a book by the title is no easy thing, and we believe that the same might be predicated of the patent before us. We are too much habituated, when about to travel in cars upon railways, to think of how great will be the distance to which we shall, in a few hours, be removed from the point of departure, to associate the same mode of conveyance with the idea of a mill-horse journey, round and round upon the same little circle; yet such is to be the progress in the present instance. This improved mode of conveying persons and things, is the old fashioned round-about adapted to run upon a circular rail of some eight or ten feet radius. The car is a circular platform, upon which seats are firmly fastened; which car, with those who have taken their seats upon it, may be whirled round at a rapid rate, by the aid of wheels and bands, or other similar mechanical appliances. These circulating vehicles are "designed for the exercise and pleasure grounds of cities, towns, villages, and all places of public resort." The great advantages of this mode of conveyance are distinctly set forth, under the following items. "*First.* The car is continuous round the whole circle, firmly united in all its parts, and driven from two opposite points, thus forming a balance of motion. *Second.* Accidents are prevented, from the impossibility of the car running off the track. *Third.* The car being driven by a chain or belt, consequently employs local, instead of locomotive power. *Fourth.* The car being continuous in a circle, will accommodate seats all around, and afford convenience for a great number of passengers to exercise and ride at the same time." The claims made include the means by which all these magnificent improvements are carried into effect.

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337. For improvements in the *Force and Suction Pump;* Abraham Kasslar, Canajoharie, Montgomery county, New York, October 28.

This is a pump with two cylinders, the pistons being worked by the same lever. We cannot find a single thing about it which can justly be denominated an improvement, the only novelty being in the particular manner of putting certain parts together, which, however, does not offer any thing worthy of imitation, and, of course not worth describing. It presents one of those cases in which a patent is granted upon a doubt of the propriety of refusing it.

338. For an improvement in *Book Binding;* William Hancock, city of London, Kingdom of Great Britain, October 28. (See Specification.)

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339. For a *Worm Destroying Medicine;* John J. Oellig, Waynesborough, Franklin county, Pennsylvania, October 28.

"Preparation of the compound sufficient to fill an ounce phial:—Oil of tansey, two drops; tincture of foxglove, twelve drops; oil of anise-seed, ten drops; oil of worm seed, one scruple; compound tincture of male fern, fifteen drops; castor oil, one ounce. The above articles to be well compounded together."

"A teaspoonful of this medicine must be given to a child every two hours, till it operates; to an adult, a phial morning and evening." The claim is to "the before described compound."

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340. For *Tonic and Aperient Alterative Pills;* John J. Oellig, Waynesborough, Franklin county, Pennsylvania, October 28.

"The following is the compound for one hundred and fifty pills:—Crab apple root bark, one drachm and a half; rhubarb, two drachms; extract of horehound, twenty grains; sal. soda, two scruples; and castile soap sufficient to make the above into a mass for pills." The claim is to "the above described compound medicine."

There are few questions of greater difficulty before the patent office than those arising upon applications for patents for medicines. Many are refused upon the ground that they offer nothing really new, and we are of opinion that the foregoing might fairly have been denied upon this ground; but the office has not the power to refuse, or to grant a patent at the discretion of the Commissioner; the law prescribes the principles upon which he is to act, and it is his duty to construe it in a manner the most favourable to the applicant; it becomes his duty to grant a patent, in all doubtful cases, and to leave the question of its validity to the courts of law. We are of opinion that a legal provision excluding medicines from the list of patentable articles, would be a blessing to the community. Such patents are not obtained by the regular scientific practitioner; he, should his experience point out the superior efficacy of any particular formula, publishes it in the journals devoted to his art, for the information of his practicing brethren, and the advantage of suffering humanity. We do not intend to stigmatize every one who obtains a patent for a medicine, by applying to him the title of quack; there may be cases in which this would not be just, but such cases are few and far between.

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341. For an improved *Steam Vessel for Cooking;* John Morris, Derby, New Haven county, Connecticut, October 28.

The patentee says that his "invention consists in forming a steam chamber with a double case, so as to admit a column of air between them; and in placing the food to be cooked within the inner chamber which receives the steam direct from the boiling water; and being surrounded with a column of hot air, the steam is prevented from condensing; and by arming this chamber with a safety valve, of peculiar and simple construction, all danger of explosion is prevented." The apparatus is clearly described and represented, and the claim made is to "the manner of constructing the ma-

chine, or vessel, for cooking by steam, and the several parts thereof combined as specified and described."

342. For an improvement in the mode of *Constructing Hubs for the Wheels of Carriages;* Howard Delano, Skaneateles, Onondaga county, New York, October 28.

This hub is to be of cast iron, in one piece, having suitable sockets, or mortices, cast in it, to receive the spokes of the wheel. To admit the axle it is to be bored in from its inner towards its front end, but leaving the metal solid in front; as the round part of the axle is to enter the hub at its inner end, and is to be confined in place by a screw cap, and its appendages. A screw is cut on the inner end of the hub, to receive the screw cap; and a groove is turned in the axle, just back of the hub, to receive a divided metallic washer against which the screw cap, when secured on to the hub, is to bear. There is a leather washer also, inserted with the metallic one, to prevent the oil from escaping which is to lubricate the hub; between this and the axle there is a chamber, or space, to hold a portion of oil, which is supplied to the chamber through a hole drilled into it for that purpose, which hole is furnished with a screw plug, or stopper.

"I claim as my invention, the mode or means by which cast iron hubs, and the wheels of carriages are attached, and held securely, by the insertion of joint washers in a groove on the arms of the axletree, and the screw cap or band embracing within it the washers, and screwing on to the inner end of the hub, in the manner described."

Specifications of American Patents.

Specification of a patent for improvements in the process of separating and removing the bitterings from the kettles or boilers used in the manufacturing of salt; granted to David Dear, *Salina, Onondaga county, New York, October 18th,* 1837.

To all whom it may concern, be it known that I, David Dear, of the town of Salina, county of Onondaga, and State of New York, have invented a new and improved mode of separating the bitterings from, and cleaning the same from salt kettles, or boilers, of any description used in the manufacture of salt, and I do hereby declare that the following is a full and exact description thereof. The nature of my invention consists in using any of the properties of ashes, such as ley, kelp, or potash, in such quantity as shall be necessary to slack, soften, or remove the bitterings from the kettles, or boilers of any description used in the manufacture of salt, without cooling down the fire underneath the kettles, or boilers of any description, in which salt is, or may be, manufactured.

To enable others to make use of, and use, my invention, I will proceed to describe the manner in which I clean the kettles, or boilers, of the bitterings collected on the inside of them by boiling salt therein. In the first place, as the kettles, or boilers, of the salt block are in full operation in making salt, I commence with any two, or more, of the kettles, or boilers, in the block, and dip the brine out of them. I then fill the kettles, or boilers, so emptied, with ley, or with fresh water, and dissolve kelp, or potash,

therein, or such other alkali as shall have the same effect, in sufficient quantity to make a strong ley thereof, which ley when heated to a boiling state has such an effect upon the bitterings adhering to the kettles, or boilers, as to either slack, or soften, them to such a degree, that they may be removed from, and taken out of the kettle, or boiler, with a ladle made for the purpose; after removing the bitterings from the kettle, or boiler, proceed to dip and clean the ley from the same, and pour it into the next empty kettle, or boiler, and then fill up the first kettle, or boiler, so cleaned of its bitterings and ley, with brine from the third kettle, or boiler; proceed in the same manner until the kettles, or boilers, in the salt block, are all cleaned of their bitterings. If the ley should become too weak by being too much used, strengthen it by dissolving more alkali therein.

DAVID DEAR.

Specification of a patent for improvements in Book Binding; granted to WILLIAM HANCOCK, *of the city of London, in the Kingdom of Great Britain, October 23rd,* 1837.

I, William Hancock, do hereby declare that the nature of my "improvements in book binding" consists in attaching or binding the leaves of books together by applying Caoutchouc, or solutions of Caoutchouc, or Caoutchouc partly in the sheet state and partly in a state of solution, in such manner to the leaves of the said books that sawing and sewing the same is rendered unnecessary, and books so bound are made to open perfectly flat, or more nearly so than books bound by any other method heretofore in use. And also in applying Caoutchouc in the said states and in such manner to the backs of the sheets of books, after they have been sewn or stitched in the usual way as greatly to improve the same in point of solidity and elasticity. And the manner in which the same is performed I shall now proceed to describe. Having folded the sheets of which the book is to consist according to the determined size thereof, whether folio, quarto, octavo or any other form, and assorted, made up, beat, and pressed, the same as is ordinarily done preparatory to sewing by the common method, I place them in a cutting press between two cutting boards, with just so much of the backs of the sheets projecting from the upper edges of the boards that on cutting away the same, which I next proceed to do with the ploughing knife, the leaves of each sheet are separated and detached at the back from one another. The surface left by this ploughing process being commonly smooth, I make it a little rough, either by rubbing it with sand paper or by rasping it with a book-binder's grater or rake. Sometimes I also avoid altogether such smoothness of surface by employing instead of the ordinary ploughing knife, a tooth plane with a very fine serrated edge. Immediately after cutting and before shifting the mass of leaves from the cutting press, I apply to the back surface so cut and prepared, a coating of solution of Caoutchouc, obtained by dissolving sheet Caoutchouc in pure spirits of turpentine, in the proportions of a pound of the former to a gallon of the latter, or thereabouts. When the said coating is dry, I add a second coating of the same solution and when that also has dried I lay on a strip or band of Caoutchouc cloth, which cloth I make by spreading a solution of Caoutchouc obtained in the manner hereinbefore mentioned, upon linen, woollen, cotton, silk, or any other flexible material, adapted to the purpose of book-

binding. To cause this strip or band to adhere firmly to the back, I apply it in a warm, sticky state, and then rub or press it on with the hand or a roller. The mass of leaves of which the book consists, will now be found so firmly cemented together, that they may be removed from the cutting press and the boarding and finishing proceeded with in the ordinary way. Instead of ploughing away the whole of the backs of the sheets as aforesaid, two or three or any greater number of broad grooves may be cut therein at equal distances, and just deep enough to go through all the folds that may be one within the other, and having coated the whole, the plain as well as grooved parts, twice over with a solution of Caoutchouc, as before directed, I insert in the said grooves, cross bands of the Caoutchouc cloth made as aforesaid, the ends of which cross bands, I attach to the boards or covers of the books in the usual manner. Instead of employing a back consisting of cloth or some other flexible material coated with a solution of Caoutchouc, I sometimes find it convenient to make use of the sheet Caoutchouc in its undissolved state, superadding thereto a coating of the solution. I find also that in the case of books in folio sheets and of books in quarto, when made up in half sheets, and of books in octavo when made up in quarter sheets, and generally of all leaves when in a simply duplicate state with a back of one fold, such sheets and leaves may be very securely cemented and bound together, without any cutting or ploughing at the back, by applying Caoutchouc in any of the states or modes aforesaid to the backs of such sheets or leaves after the same have been assorted, made up, beat, and pressed, as aforesaid, for the purpose of binding. When a book is composed of leaves originally single, I plough and rasp them in the manner before described; if such leaves are of large dimensions, such as plates or maps, I attach to the back edge of each, by means of a solution of Caoutchouc, obtained as aforesaid, a strip of cotton or other suitable material of such size that it overlaps the leaf to the extent of about a quarter of an inch on each side, and then make up and bind together the sheets so individually prepared in the manner hereinbefore directed for binding books of other descriptions. I find also, that when books are sewn or stitched in the usual way, the solidity and elasticity of the backs thereof are greatly improved by applying thereto Caoutchouc, or solutions of Caoutchouc, in the manner hereinbefore directed with respect to books consisting of quarto, or other sheets with backs of only one fold.

And having now described the nature of my said invented improvements in book-binding, and the manner in which the same are to be performed, I declare that I do not claim as new or of my invention, the employment of Caoutchouc in book-binding, but that I claim as new and of my invention the employment of Caoutchouc in book-binding in the manner and modes hereinbefore set forth, so that the sheets or leaves of books are in some cases bound together without sawing and sewing, and books so bound, open perfectly flat or more nearly so than books bound by any other method heretofore in use. And in other cases when books are sewn or stitched in the usual way, the backs thereof are greatly improved in point of solidity and elasticity. And I claim as comprehended under my Patent, any and every other mode or manner of employing Caoutchouc to produce the new and useful effects aforesaid which shall involve no material departure from the manner hereinbefore specified.

WILLIAM HANCOCK.

Report of Magnetical Experiments, tried on board an iron steam vessel by order of the Right Honorable the Lords Commissioners of the Admiralty. By Edward J. Johnson, Esq., commander, R.N., F.R.S.

The very extensive use of iron in the construction of modern vessels, and still more recently, the formation of steam vessels entirely of that material, has rendered the compass, notwithstanding its successive improvements, little more than a piece of useless lumber; or, more properly speaking, it is become unworthy of confidence; and, consequently, where it is trusted, a deceptive and frivolous apparatus. Indeed, the compass in its rudest form, even the Chinese, or the early European, with ships built as ships were then built, was worthy of far greater confidence than the most improved compass is on board a vessel of modern construction. There is no doubt, indeed, that were the weather always clear, the compass might be advantageously dispensed with in maritime affairs; but, as during not only days but weeks of the most tempestuous weather, when not a single lunar observation can be taken, nor any kind of complete observation made, the vessel is driving about amongst known or unknown dangers, it cannot but be viewed as a most perilous condition, when the direction itself upon which she is sailing, is a matter of almost total uncertainty. If indeed, she be out at sea, and far from land, she is safe, provided her strength be sufficient to ride out the storm: but every year, we are well assured that numerous cases of heart-rending scenes of wreck and desolation would be escaped had they the power to ascertain the course upon which they were bearing. This, however, is utterly impossible, as ships are now built, by the use of the compass simply.

Mr. Barlow's correcting-plate is, on this account, one of the greatest boons conferred on modern navigation. This term, as most of our readers are aware, is something of a misnomer; since the plate, instead of correcting the error produced by the iron of the ships, *doubles* it; but we would not quarrel with names—as it is with things we have to deal. It enables us, by a very simple numerical process, to ascertain, approximately, the effect of the iron of the ship upon the direction of the needle, and to make allowance for it in our reckoning.

It is strange, however, to witness the apathy with which the reckless seamen, in time of security, look upon the possible danger of a future, and not remote, period. A single hour in port would enable the master to find the effect of his iron with considerable precision: and yet this single hour he thinks it too much to give to his own and his crew's future safety. Strange infatuation!—but infatuation almost always follows close upon the heels of familiarity with danger.

We do not require to be told that Barlow's plate is not perfect. This we are as fully aware of as any one: and we do not urge implicit reliance upon it, in any sense of the word, under all possible circumstances. Still, if it enable us under all conditions to ascertain the amount of the effect of iron *approximately*, and often within very narrow limits, surely we must be determined upon rushing into danger, if we do not avail ourselves of it to the degree in which it can assist us. We are utterly opposed to the use of the compass at all, in those cases where it can be dispensed with: but as cases so perpetually occur where it is our *only* guide, and those cases pre-

cisely those of the greatest danger, it is surely worthy of the most serious attention, from every practical navigator, as well as from men of science.*

At the period when Mr. Barlow proposed his plan of the correcting-plate, he had in especial view the effect of the immense masses of iron which the guns on board men of war contained. Of course, *cæteris paribus*, the same circumstances would occur on board the smaller vessels in the merchant service, and require correction accordingly. The recent introduction of iron steamers has, however, given a new and important interest to this contrivance. These are chiefly designed for passengers, and, in some cases, more than five hundred are crowded on board a single steamer. We do not indeed, just now, know to what extent the iron steamers have been introduced: but as they have many advantages, in respect to security and convenience, over those of wood, they will most likely supersede them entirely, *provided they can be rendered as safe for the purposes of navigation by the compass*,—circumstances giving rise which must inevitably occur in all voyages of any considerable extent. The inquiry into this possibility, it was the main object of Captain Johnson's experiments satisfactorily to answer; and we proceed to give a brief analysis of them.

The Dublin Steam Navigation Company placed at the disposal of the Lords Commissioners of the Admiralty a fine new vessel; built entirely of iron, the *Garryowen*, for the purpose of investigating the effect of the vessel upon the indications of the compass, in any way that their Lordships may think proper.† They appointed Captain Johnson to make the requisite experiments; and he repaired in her to the port of Limerick, in the autumn of last year, to carry them into execution. The results have been printed for the Royal Society's Transactions; but they are not yet published. We avail ourselves, however, of a copy of the Memorial, with which we have

*In an early number we shall give a thorough examination of the principles of Barlow's correcting plate; and endeavor to show the degree of theoretical evidence combined with experiment, this method has for its foundation.

†Weight of iron.—Total weight of iron, including hull, machinery, anchors, cables, &c. . . . 180 tons.

Weight of iron in hull	. .	95 tons.
Do. engines	. . .	40 "
Do. shafts and wheels	. . .	12 "
Do. boilers	. . .	30 "
Do. chimney	. . .	1 10
Do. anchors and cables	. .	1 10

Stem, 14 feet long × 4 feet wide.
Beam, 4 in. deep, 4 in. wide, bound with iron plates.
All the iron used in h hull and boilers is malleable.

Dimensions of Vessel, &c.

Length on deck 130 feet; beam 21 ft. 6 in.
Do. keel, 122 3; depth 11 ft. 0 in.
38 double frames a-midships, of angle iron 2 in. wide × 3 deep × ½ in.

17 single frames forward, of	. .	3 × 3 × 5-8
22 do. aft,	. .	3 × 3 × 5.16
Diameter of chimney	. . .	3 feet.
Height of ditto	. .	28

Draught of wat r, forward 5 ft. 3 in. aft 5 ft.

Two Engines=85 horse power.

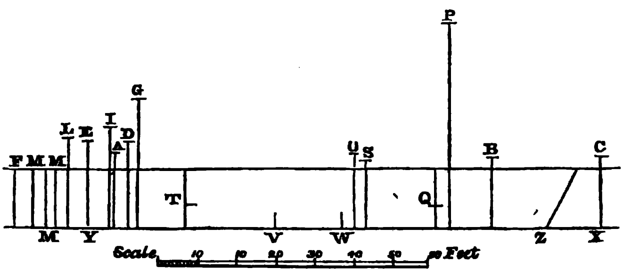
Diameter of cylinder	. . .	3 ft. 0 in.
Diameter of wheel	. . .	15 ft 6 in.

Engine makes 27 strokes per minute.

been favoured, to lay before our readers a succinct account of them, and a few reflections on the results they bring to light.

There being no wet dock in the port of Limerick in which the *Garry-owen* could be conveniently swung round, to make the observations in different azimuths, point by point, he fixed upon a position in Tarbert Bay, well adapted to his purpose. His operations were commenced on the 19th of October, and continued, as circumstances permitted, till the 18th of November.

In order, however, to show the positions in the vessel at which the several observations were made, the following diagram is given. The line Y Z is the keel, Y being the stern, and Z the stem; V is the place of the chimney, and W the axle of the paddle-wheel. The positions of the other points will be easily judged of, from the accompanying scale and table: and these designate the positions of the compasses named by the several letters themselves.



A Quarter deck, 5 feet 9 inches above the deck.
B Forecastle, 5 feet 11 inches above the deck.
C Bowsprit, on glass-legs.
D On the fore-part of the temporary poop, above deck 8 feet $5\frac{3}{4}$ inches.
E On the after-part of the temporary poop, 8 feet 5 inches from the deck.
F On a stage level with the taffrail.
G On a plank 4 feet below the main-gaff end, and above deck, 20 feet 5 inches.
I On the centre of the temporary poop, above deck 13 feet $4\frac{1}{4}$ inches.
L On the poop projecting over the stern.
M M M Three stations on the stage over the stern, level with the taffrail.
O Between the paddle-boxes.
P Two-thirds up the fore-topmast, above the deck 40 feet 2 inches.
Q (On glass legs) in the fore-hold.
S In the iron sphere a-midships, above deck 7 feet.
T In the cabin.
All made in the middle of the vessel, 9 feet 11 inches from each side.

After the preliminary operations of fixing stations, &c. were gone through, Captain Johnson saw it to be necessary to put all the iron which the vessel carried, in the places which it usually occupied during the voyage, such as the anchors, cables, &c. He then tried the effect of the whole in that direction of the vessel where, in the generality of cases, the deviation had been found to be a maximum, so as in some degree to guide him in the se-

lection of a place for the principal observations,—or that, which his orders especially directed, in which to place a steering compass, and where the effect of the plate may be successfully tried.

With this view, the vessel's head was warped to the true magnetic east, and the deviations at several parts of her ascertained:

At B, the deviation of the marked end of the needle = 16° E.
Near the centre, and before the funnel, it was = 26° 20′ E.
At A, when the boats' davits were out = 11° 40′ E.
. . were on board = 6° 20′ E.

The preceding facts, showing the influence of iron in the vicinity of the compass, may be worthy of the attention of the practical navigator, for they show, at a position not far from the binnacle, a difference of deviation of no less than 5° 20′ under the mere circumstance of swinging the quarter boats' davits in board, from their usual position where boats are hoisted up, to that place in which they would be secured in stormy weather at sea.

Though the principal object of these experiments was to determine the best position for a steering compass on board the iron steamer (which induced him to select A and B as especial places of observation,) Captain Johnson tried the effect of the vessel at all the places in the table given above. We need not follow him through all the details of the precautions which he used for insuring the elimination of all foreign influences of an accidental kind, nor of those for securing good observations. A brief statement of the positions is, however, necessary.

A fixed station X* was selected on the south-west side of Tarbert Bay, a mile distant from the vessel, from which the cone of the mountain Dicomede, in the county of Clare, distant about nineteen miles, was distinctly visible. The bearing of it was determined by the compass which was afterwards used at station A on board the vessel; the magnetic meridian was also then determined by this compass, and a distant object in that meridian on land, was noted. The theodolite, in the succeeding observations, was placed at X in the same position as the compass, thereby rendering the simultaneous observations at A and X virtually identical with those which would have been determined by one compass only. The vessel was then taut moored in the line between the station X and the cone of the mountain,—in the line of direction of which was also a remarkable heap of stones on Kilkerran Point,—so that the vertical wire of the theodolite at X bisected these objects and the instrument on the forecastle of the vessel.

The bearings of the cone of the mountain from the positions A and B as well as the simultaneous bearings between A and X, were observed when the vessel's head was at each point, and from these bearings between A and X the deviation of the compass produced by local attraction was deduced. Of course we cannot give the tables entire, and we mention the circumstances under which the observations were made, to show that every requisite care was used to ensure correct results. We are, however, still under the necessity of giving one, referring our readers to the paper itself for the others. This contains the simultaneous observations made with nine compasses in different parts of the vessel, the bell being struck as a signal for observation. *See Table.*

*No figure is given to these descriptions; nor is any necessary, as the reader can easily sketch it from the verbal statements.

Date.	True magnetic direction of vessel's head.	Direction of vessel's head by compass F.	Deviation at F.	Direction of vessel's head by T.	Deviation at T.	Direction of vessel's head by G.	Deviation at G.	Direction of vessel's head by A.	Deviation at A.	Direction of vessel's head by O.	Deviation at O.
		° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
Nov. 5.	North.	North.	0 0	N. 26 0 E.	26 0	N. 1 0 E.	1 0	N. 8 20 E.	8 20	N. 16 30 E.	16 30
Therm. 52° 1.	N. E.	N. 33 0 E.	12 0	N. 74 30 E.	29 30	N. 45 0 E.	0 0	N. 55 0 E.	10 0	N. 72 0 E.	27 0
Barom. 29.8.	East.	N. 67 0 E.	23 0	S. 59 30 E.	30 30	East.	0 0	N. 80 40 E.	9 20	S. 66 0 E.	23 0
	S. E.	S. 64 30 E.	19 30	S. 30 15 E.	14 45	S. 45 0 E.	0 0	S. 39 30 E.	5 30	S. 35 0 E.	10 0
Nov. 4.	South.	S. 1 0 E.	1 0	S. 10 30 E.	10 30	S. 1 0 E.	1 0	S. 1 0 E.	1 0	S. 5 0 E.	5 0
Therm. 56°	S. W.	S. 65 0 W.	20 0	S. 8 30 W.	36 30	S. 45 0 W.	0 0	S. 33 0 W.	12 0	S. 26 0 W.	19 0
Barom. 29.7	West.	N. 66 30 W.	23 30	S. 35 30 W.	54 30	N. 85 0 W.	5 0	S. 80 0 W.	10 0	S. 63 15 W	26 45
	N. W.	N. 32 0 W.	13 0	N. 30 0 W.	15 0	N. 40 0 W.	5 0	N. 38 0 W.	7 0	N. 64 0 W.	19 0
		Direction of vessel's head by Q.	Deviation at Q.	P.	at P.	B.	at B	C.	at C.		
Nov. 5.	North.	N. 18° 0′ E.	18 0	N. 1 24 E.	1 24	N. 9 40 E.	9 40	N. 1 24 E.	1 24		
Therm. 52° 1.	N. E.	N. 56 15 E.	11 13	N. 47 48 E	2 48	N. 56 0 E.	11 0	N. 43 36 E.	1 24		
Barom. 29.8.	East.	S. 73 8 E.	16 52	S. 81 33 E.	8 27	N. 82 30 E.	7 30	East.	0 0		
	S. E.	S. 36 33 E.	8 27	S. 42 12 E.	2 48	S. 41 0 E.	4 0	S. 42 12 E.	2 48		
Nov. 4.	South.	S. 9 51 E.	9 51	South.	0 0	S. 5 0 E.	5 0	South.	0 0		
Therm. 56°.	S. W.	S. 14 3 W.	30 57	S. 41 30 W.	8 30	S. 27 30 W.	17 30	S. 45 0 W.	0 0		
Barom. 29.7.	West.	S. 59 3 W.	30 57	S 84 23 W.	5 37	S. 73 30 W.	16 30	N. 86 30 W.	3 30		
	N. W.	N. 32 21 W.	12 39	N. 47 48 W.	2 48	N. 40 30 W.	4 30	N. 36 33 W.	8 27		

In looking at this table, it is impossible not to be struck with the immediate effect of the iron composing the vessel and her works, upon the indications of the needle, as the ship's head is turned into different azimuths, being in some cases even more than five points. It is also evident, that in different vessels this will very materially vary, and that little assistance can be derived from experiments made in one vessel towards guiding us in judging of the influence of the iron in another of a different, or even of a similar construction,—so far as form and disposition of metal are concerned in rendering them similar. To this, however, we shall speak presently. It is true that at G, C, P, the influence is much less than at any of the other positions where the observations were made; but as these are positions at which, in actual navigation, the observations could not be conveniently made, there can be no inference in favour of the employment of iron steamers deduced from these,—however interesting they may be in reference to some questions concerning the extent of the influence of iron on the magnet, and upon the law of its decrease of force as the distance is increased.

The result of these observations, as well as his first already mentioned, was conclusive to Captain Johnson's mind, that for the purposes of navigation, his observations should be chiefly confined to the positions A and B. Of two series of such observations, the discrepancies are unaccountably great, and especially so, seeing that every possible precaution was taken to secure a sameness of circumstances under which to make the observations. Captain Johnson was not, however, so much surprised at this circumstance as we should have expected; as he had remarked that the "embarrassment in the movement of the needles" after the first series, in some degree prepared him to expect it,—or, in other words, the difference in the magnetic state of the needles themselves, induced by the first series, was so great, that their indications would be materially altered in the second. This we can easily, to a certain degree, but not to the amount which these experiments indicate, conceive; the directive force of the needle may be increased or diminished by induction we admit, and then the power of the iron remaining the same, its influence would be accordingly less or greater upon the position of the needle when out of the magnetic meridian: but still that pure iron should induce *so much permanent change* in the magnetic state of the hard steel of the needle is to us inconceivable. All experiments go to prove the reverse of this. Captain Johnson's subsequent experiments prove the reverse of this, too; for they actually show that the vessel herself was a *permanent magnet*, and not a magnet by induction, as cast-iron is generally found to be. Now the needle itself could produce no sensible effect upon the state of the larger magnet; and hence her power upon the needle would be sensibly the same in both series of experiments, whilst that of the needle to resist her influence may be varied in a great degree. Captain Johnson is led to attribute the different effects (in another series of experiments which he afterwards made with the same needles) of the head and stern of the vessel to the needles placed upon the quay, to the different disposition of the quantity of iron in those two parts of her; but at the distances at which he observed these deflections, we cannot account for it on these principles, especially keeping in view the very minute influence recorded to have been exercised upon the needles at G, C, and P, in his former experiments, in the table which we have copied above.

The intensity of the magnetic force in the needle was greatly altered by the iron of the vessel; the dip was also very greatly altered. All this, of

course, we should expect; but we wish the *intensity* of the needles had been observed on shore both before and after the experiments were made on board; and as nearly as possible under the same circumstances. This, we consider an unfortunate omission; but we do not blame Captain Johnson for it. The time of the year was unfavourable, affording so few days fitted for observation, and the period allotted to the whole series was much too short under such unfavourable circumstances. If we are not mistaken, other observation, too, were made which are not here published; and, possibly, when they are made public, they may throw some further light upon the phenomena. However, in this respect, we are not able really to say what those observations were, nor whether they at all bear upon this question. If they do, it was a mistake to withhold them from the scientific public on the present occasion.

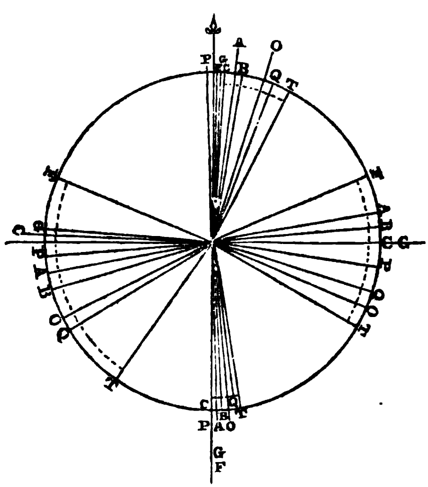
The two following diagrams exhibit visually the several circumstances of these experiments; and require scarcely any description.

Diagram I, represents the deviation of several compasses, when placed in different parts of the vessel, when her head was in the true magnetic direction of the cardinal points of the compass.

Diagram II, represents the comparative dip of the magnetic needle, on Tarbert Islands and that observed at three positions on board the *Garry-owen*, in Tarbert Bay, when the vessel's head was to the true magnetic north and south.

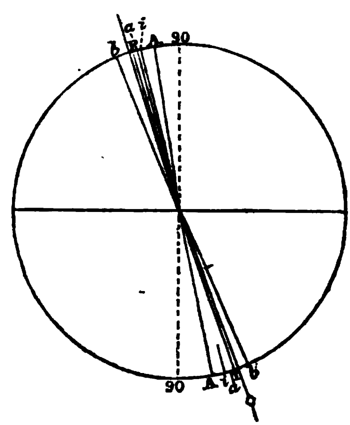
Diagram I.

True Magnetic North.



Magnetic South.

Diagram II.



Dip on shore.

A, I. Dip observed at those positions with the vessel's head to the north.

a, i, b. Dip with vessel's head to the south.

When we consider the great number of parts of which a vessel is composed, and the processes by which those parts are formed, we can hardly be justified in considering the vessel as other than *an immense magazine of permanent magnets* fastened together. Were they all, indeed, so placed in building her, that their axis may be parallel, we may be better able to form

some general idea of the magnetic resultant, (so to speak,) and to guess at the intensity and directive force exerted by the whole system; but, even then, the difficulties, in the present state of magnetic knowledge, would be absolutely insurmountable. When, however, we consider the effect of a single and slight stroke with a hammer upon a permanent magnetic bar—the total disregard paid in building the vessel as to the magnetic state of her materials—the utter impossibility of ascertaining it after they are put together, or to alter it, definitely, in any one of the pieces—when we consider that *malleable* iron can alone be employed, and that all these difficulties stand in the way of even placing the component parts of the compound magnet parallel to one another, we say, we are compelled to affirm, that the real magnetic state ot an iron ship is incapable of being ascertained by any series of experiments whatever. Captain Johnson's experiments verify, but do not in our minds strengthen, our convictions on this head. They were formed, *à priori*; and from the view which in common with all scientific men, we had before taken of the necessary consequences of the most familiar phenomena, as well as of the diversified experiments of a more refined class carried on by the most eminent philosophers for many years. Instead, therefore, of considering the steamer as a single permanent magnet, we ought to consider her as a vast apparatus of united magnets, distributed perfectly at random; and their relative positions and intensities altogether incapable of estimation. Are we not justified, then, in saying, as we have said above, that we are incapable of judging from a series of experiments made on board one vessel, what the effect of one (so far as general form and disposition of material are concerned) similarly built in all respects may be? Surely, we are.

Let us, however, even waive this objection. Have we not seen that on board the *same vessel*, on two different days not very remote from each other, the deviation of the *same needles* was very different when all circumstances were alike, except that the magnetic states of the needles were *themselves changed* by the first series of observations? We do not, indeed, know where the needles were placed during the intermediate period,—whether ashore or on board. If on shore, the influence of the short period during which the first observation was made, is only indicative of the intense action of the compound magnet, which could, in so short a time, produce such a permanent change in the needles: if on board they were probably kept in the positions of observation, and if so, it proves how dangerous it is to trust to the *same compass, from one day to another*. The compass with which we leave port is a different compass after a single hour's voyage, and after three or four days, has been "deteriorated" to such a degree as to be unworthy of the slightest confidence.

When we look at the matter in this light, we need not inform our readers that we look also upon all attempts at the correction of the local attraction, by means of Barlow's plate, as utterly useless *on board an iron steamer*. Upon this subject, however, as we said before, we intend to speak more fully in a future number: it is sufficient to say here, that Captain Johnson appears to have made but few experiments with it, owing to the "unfavourable state of the weather." It is very true that unfavourable weather is disadvantageous for good experiments for mathematical investigations of the *laws* which reign through physical phenomena; but we do really think, that, from the circumstance of the knowledge itself being only required in bad weather, the present was an advantageous opportunity thrown away; inasmuch as the amount of discrepancy to be expected in times when the com-

pass is our only trust, is in a practical point of view, infinitely more important than a knowledge, however accurate, of the laws which prevail when the compass is never recurred to by a properly educated sailor. It is surely of greater consequence to know how far we may *safely* trust our instruments, at the time when they are our *only* trust, than to ascertain their laws in a state of comparative repose, and when they are altogether unnecessary to our safety.

Finally, we feel it our duty to our readers and to the public, to express emphatically, our conviction of the extreme danger of this class of vessels, for the purposes of navigation by means of the compass,—or, in other words, for venturing out of the mouth of a river. It is neither our wish, nor our interest, to discourage the progress of the arts and manufactures of our country; but it is both our duty as scientific journalists, and our spontaneous feeling as men, to warn our countrymen against the dangers to which they may expose themselves, by stretching beyond its due limits, the application of any product of our manufacturing ingenuity. We are fully aware of the advantages which belong to the use of iron, in the construction of iron steamers; but we also wish our readers to be fully impressed with a sense of their recklessness in daring all its dangers. We should not fulfil our duties towards them, did we not distinctly tell them, that the iron vessel is in precisely the same condition with respect to the compass, as if no compass had ever existed,—or, in some respects, even a worse condition,—since they may be led to trust to a guide that *cannot* guide them aright and neglect those slight glimpses of indication which may in some small degree assist them. Such, at least, is *our view* of the matter; and if we are wrong, we hope we need not say, that we shall be extremely glad to be enlightened on the subject, by those who see better than we can.

We do not think it necessary to give here Captain Johnson's determination of the best position for a sailing compass on board the *Garryowen*, as, even abating all other objections to the use of this kind of vessel, we have given good reasons why it could not be depended on for any other vessel similarly built,—much less for one in which a different disposition of materials may be adopted. On the care bestowed upon the experiments, as well as on the *evident honesty* of their record, we cannot speak too highly, and we are glad to find such men are found by the Admiralty, to be entrusted with this class of expeditions. We cannot, however, in respect to its scientific value, but regret that a more complete apparatus was not furnished to him, and that a more suitable period, both as to date and extent, was not selected for the purpose.

Mag. Pop. Sci.

On Lightning Conductors, particularly as applied to Vessels. By Martyn Roberts, Esq.

Read before the Electrical Society of London, June 24th, 1837.

As accidents, attended with loss of lives and property, are constantly occurring in our Royal Navy and Mercantile service, from the effects of lightning, notwithstanding the provision often made for their defence, I have been induced to turn my attention to the subject, as well in a philosophical, as in a nautical point of view, and I trust *by an examination of the causes*, and a *citation of a few effects* consequent upon them, *to solve the embarrass-*

ment under which we now lie, and *to point out the means* whereby such disastrous consequences may in future be prevented.

The causes may be traced to two principal heads, namely, the form, and the position, of the conductor used at sea. The conductor most in use is a chain, each link of which becomes, by the action of the saline moisture of the atmosphere, highly oxidated, and as oxide of metal is a non-conductor of electricity, we have at every junction of one link with another, a solution of continuity in the chain regarded as a conductor of electricity, and therefore when the vessel is struck by lightning, every joint of this conductor becomes a point at which an explosion may take place, and where consequently the electric fluid may strike off in any direction whatever.

Its position, when the royal and top-gallant masts are struck, is often productive of danger and inconvenience, for the portion of chain not then stretched, (the spare part) is allowed to remain on deck, or towed overboard, either position being one of danger to the ship. The other form of conductor used is that invented by Mr. Snow Harris, with considerable ingenuity, but, in my humble opinion, by no means tending to diminish the danger. Mr. Snow Harris' plan is to let into the after part of the masts a strip of copper, of considerable surface, but of little thickness, (under the conviction that superfices, not content, conducts electricity,) from which opinion I must beg leave to differ, as it is decidedly contrary to experiment; and if he made his strips thick enough to be efficient, they would materially injure that essential quality in masts, pliability.

While differing so widely from a gentleman for whose talents I have the greatest respect, I feel myself called upon to lay before the society a few of the effects likely to result from an adoption of the system he advocates.

As before mentioned, he proposes that a strip of copper be let into the after part of each portion of the mast, viz: the royal, top-gallant, top, and lower mast, through the keel into the water.

Now, in the first place, at every joint of the mast there must be a separation in the copper to allow the masts to be lowered, the same effects must be expected as have been condemned in the chain; and even supposing the lightning to pursue its course downwards over the copper strip, it appears to me highly dangerous to conduct such an immense accumulation of electric fluid as that in a lightning cloud, into the body of the vessel, close, generally speaking, to the powder magazine, or at all events among many substances that would produce awful effects from its action on them: the lateral explosion, of which I here speak, can easily be proved by experiment, to take place even in the transmission of the feeble quantity of electricity generated by our machines, what great reason then have we to dread the enormous quantity of the fluid which will be conveyed into the hull of the ship? Indeed Mr. Harris himself gives an instance of most serious injury, arising to a sailor leaning against a mast through which the lightning was transmitted.

From what has been instanced, I feel confident that few will dissent from the position I wish to defend, *that a perfect metallic continuity of conduction from the mast head to the water, and also a transmission of the fluid through a channel far removed from the interior of the ship, is absolutely necessary for the protection of vessels from Thunder Storms.*

To attain this desideratum *under all circumstances*, I beg leave to propose the following plan.

Let conductors be made of metallic rope, consisting of some hundreds of fine annealed copper wires, laid up as a common hemp rope; it will be pliable, and may be rove through blocks, and traverse as well as any other

rope. Let this rope be fixed to a copper point at the highest mast head, led down the after part of the mast, until it arrives at the lower mast head, and from thence led as a backstay to the outside of the ship, and there fastened to her copper sheathing. By this means a perfect metallic conducting channel is maintained for the lightning, from the highest point to the water, without interruption or contact with any thing that can possibly produce ill effects.

Annals of Electricity.

West's Patent Forge-backs.

The rapidity with which forge-backs of the ordinary construction are destroyed by the intensity of the heat to which they are continually subjected, has led to the invention now described, and which was patented by Mr. West, of Crayford, a blacksmith, in December, 1834. The invention consists in the introduction of a current of water behind the forge-back, which, as is obvious, preserves the metal from destruction by the fire.

Fig. 1.

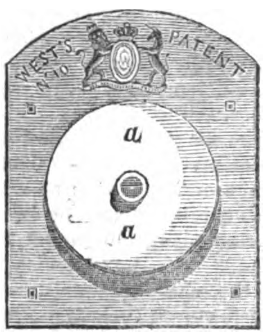


Fig. 2.

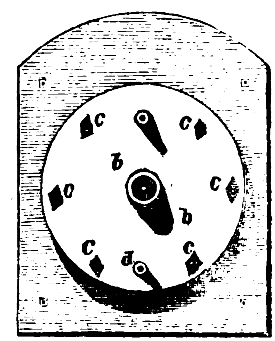


Fig. 3.

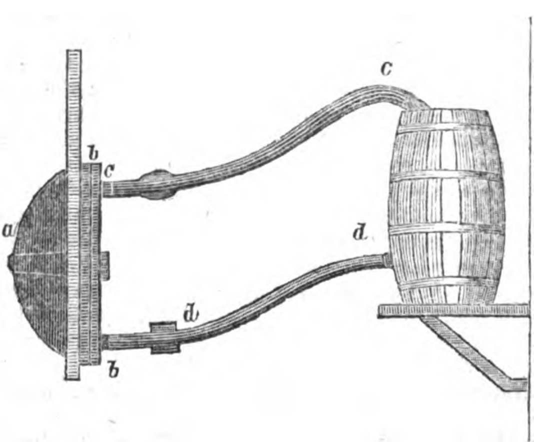


Fig. 4.

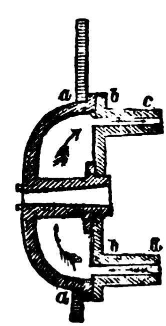


Fig. 1, represents a front view of a forge-back, which is made hollow in order to admit of a flow of water.

Fig. 2 is a back view of fig. 1, by which the position of the circulating pipes is shown.

Fig. 3 is a side view of a forge-back.

Fig. 4 is a side section, by which the action of the water will become more evident, the arrows indicating the flow of the water.

The back of the forge is made up of two parts, *a* and *b*—the part *a* being the front, or part against which the fire or hot coals lie, and is consequently that part in the ordinary back which is liable to be quickly destroyed; but when constructed in such a manner as to admit of a constant flow of water against the back surface, this part *a* will be less prejudicially acted on by the hot coal, owing to the heat being constantly conveyed away by the circulation of the water. *b* is the back part of the forge-back. These parts are kept together by screws. *d* is the induction pipe, and *e* the eduction pipe, which respectively lead from and to a tub or vessel containing water, which is placed in any convenient situation in order that water may constantly flow to and from the hollow forge-back *a b*.

The advantages of these backs are their indestructibility—that the clinker does not adhere to the back, and consequently that the fire need never be disturbed for the removal of the clinkers—that they always burn coal; and as every smith is aware that they never work so comfortably, nor get their heats so well as they do while the back of the forge continues cool, this must be a great recommendation.

There is also a positive saving of more than twenty per cent in coals.

The tub or vessel for the water may be placed in any part of the shop, so that it is above the level of the back, and one tub or vessel will do for any number of backs.

The back is to be connected to the reservoir or tub by leaden pipes.

Lond. Mech. Magazine.

Smoke Burner.

The following is a short description of Messrs. Chanter and Gray's smoke burner, which has been publicly exhibited at their premises, in Earl street, Blackfriars, and inspected by their Royal Highnesses the Dukes of Sussex and Cambridge—the former attended by several Fellows of the Royal Society. It has also been inspected by many engineers and gentlemen interested in the progress of science, all of whom agreed in admitting the object of consuming the smoke to be fully accomplished. It will, therefore, really be a great neglect on the part of the Legislature, if manufactories and gas works are longer suffered to darken the atmosphere of the metropolis with coal smoke. As to the parties interested in locomotive engines, they must decide for themselves; but if the estimate be correct, that they can obtain from coal a heat greater than they now obtain from coke, and at less than half the expense, it may readily be supposed that they will soon avail themselves of this patent.

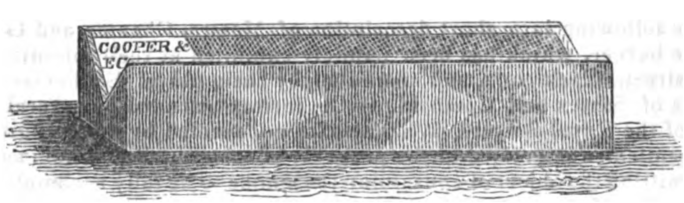
Description of the Smoke Burner.

It would be impossible to describe fully the nature of this invention within the limits of a prospectus, but it may be briefly stated that its principle essentially consists in so arranging the form of the furnace and position of the bars, that the fuel is regularly advanced by gravitation upon inclined fire bars, without the aid of machinery, or any apparatus

besides the simple instruments in common use for the management of furnaces; the carbon and various inflammable gases are set free in the process of combustion, and being more charged with the oxygen of the atmosphere and heat of the fire, proceed through and over the fire, which, increasing in heat to its termination, gradually subjects the less combustible gases to perfect combustion. Saving in fuel is thus effected; for, in the present furnaces, these are not only passed off unconsumed, but by preventing the ignition of more combustible materials, necessarily waste a large portion of the burning fuel. Thus the primary effect, in the operation of the patent furnace, may be stated to be that of obtaining, at the termination of the furnace, that intense degree of heat indispensable to the entire combustion of the various substances emitted from the burning fuel. It is needless to add, that this produces extraordinary economy of fuel. This invention is exhibited in the specification in twelve different forms, showing its application to every description of furnace. The details are somewhat varied; but the most important part of the principle, namely, the absolute combustion of the vapour is thus effected in all of them Mining Journal.

The Patent Styloxynon.

From the great personal convenience I have myself experienced, in the use of the ingenious little instrument of which a sketch accompanies this communication, I feel assured that I shall be rendering an important service to all such of your numerous readers as are draughtsmen, by introducing it to their notice through the medium of your pages. The drawing, which is the full size, represents Messrs. Cooper and Eckstein's patent pencil pointer, which they have appropriately termed the *Styloxynon*; it consists of two sharp files neatly and firmly set together at right angles in a small block of rosewood.



The instrument thus formed, speedily produces a most delicate point to black lead, slate, or chalk pencils, and will be found generally useful for renewing the points of various other articles in common use.

A point as fine as that of a needle, may be given to good HH or HHH pencils, by means of the Styloxynon, and this instrument will be found an invaluable addition to the drawing table of architectural and mechanical draughtsmen in particular, as well as for artists generally. The mode of using it is merely to rub the pencil backward and forward with the point slightly depressed in the angular groove, turning the pencil round at the same time between the finger and thumb, when a most exquisite point will be produced, which by occasional recourse to the Styloxynon may be maintained at pleasure.

When a new pencil is first used, it should be roughly pointed with a knife before employing the Styloxynon.

Wm. Baddeley.

Lond. Mech. Mag.

Note.—This instrument, if constructed of good coarse files, would be very useful in a laboratory for rounding and fitting corks for jars and bottles. G.

Plan of a Navigable Raft in case of Shipwreck.

Having got together (from the wreck or by other means) a quantity of stout planks, capable of supporting the requisite number of hands with provisions, &c., arrange them side by side in the form of an oblong square, the breadth being one third of the length; then lay at equal distances across them, a sufficient number of others as beams or treadles, to stiffen and hold the raft together, pinning them down with nails, or, if these are inaccessible, with wooden pegs, which swelling in the water will hold firm enough. Now raise the sides and one end perpendicular, (two or more feet according to the size of the raft,) sloping up the other for a bow, like the swim of a barge. The sides being nailed on, should be stayed up with a few brackets inside; and rigging her with a mizen royal, or a couple of boat's sails, with an oar, or paddle shaped plank for helm, the raft is furnished. Half a dozen spare planks slung over the bulwarks by one end, as leeboards, would make her hold an excellent wind. She would be as stiff as a church, and if constructed (as she should be) of large superfices in proportion to her burden, would, from her light draught and extent of floor, be both a fast and a good sea boat. If loaded below the thickness of her bottom, she should be caulked, if otherwise, not, as then any water she might ship escaping between the planks, she would be a life boat and could not be swamped. This plan was originally intended, only as a resource, for the purpose of reaching a civilized port when cast away on a barren, or distant coast; but on reconsideration, I see no reason to hinder its construction on board a vessel, provided sufficient materials are handy. The planks lying flat on deck, would not wash off, but in a very heavy sea. The work is of the simplest and roughest kind, and might be completed in a few hours where the danger is not immediate.

A Youngster.

Naut. Mag.

Captain Ericsson's Patent Sounding Instrument.

We have been favoured with a copy of the certificate granted by Commander Bisson to Captain Ericsson, which we have great pleasure in subjoining:—

"*To Captain Ericsson.*

"My Lords Commissioners of the Admiralty having ordered a trial of your patent sounding instrument, I was directed by Rear Admiral the Honourable Sir Charles Paget, on the 12th of this month, to proceed in his Majesty's brig Partridge, under my command, towards the Atlantic Ocean for that purpose. I have, accordingly, to certify, that

I have put your sounding instrument to a complete practical test, by using it every second hour, by day and by night, for nine days, beginning with a depth of 5 fathom, and extending to 600 fathoms. Soundings up to 80 fathoms being obtained whilst going at the rate of 6 knots per hour.

"Respecting the accuracy of the instrument, I have only to state that I found it perfect, and as to simplicity, I need only say that all my crew soon understood its use, and on these grounds I can strongly recommend this instrument as being one of great practical utility.

"PHILIP BISSON, Lieut. and Com.

"Plymouth, this 22d day of Sept., 1836." Lond. Mech. Mag.

A simple method of Drawing on both sides of a Board without either being Rubbed.

To effect this, I think that two slips of wood of the same thickness, provided with pins, say two at each end, and these made to fit in corresponding holes in the drawing board at top and bottom, would be sufficient for the purpose. By these means a sheet of paper could be laid on both sides the board, and be used at the same time by reversing the pieces of wood from one side to the other, as occasion may require. The holes should be near the edge of the board to allow as much room as possible for the paper. Ibid.

Railway Transit.

It would require 12 stage coaches, carrying fifteen passengers each, and 1200 horses, to carry 180 passengers 240 miles in twenty-four hours, at the rate of ten miles an hour. One locomotive steam engine will take that number, and go two trips in the same time, consequently, will do the work of 2400 horses! Again, it would require thirty mail coaches (six passengers each) and 3000 horses, to take 180 passengers and mail, 240 miles in twenty-four hours, at the rate of ten miles an hour. One locomotive steam engine will take that number, and go two trips in the same time, consequently, will do the work of 6000 horses!—*T. M.*

Ibid.

NOTICES FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

Fabrication of a Steel called Meteoric Steel. BY M. FISCHER.

This process consists in combining with cemented steel, or steel of any kind, in variable proportions, certain alloys which have the property of increasing its good qualities and rendering it fit to receive impressions or designs, similar to those of Damask. It is produced in the following manner:

Take 4 parts of zinc, 4 of pure nickel, and 1 part of silver;—put the whole in a black lead or other refractory crucible, cover it well with pulverised charcoal and lute on a cover;—then subject the crucible to the heat

of a powerful melting furnace until the mixture is perfectly fused. Pour it, when very liquid, into a vessel filled with cold water, to render it brittle and carefully pulverise it in a cast iron mortar.

When a sufficient quantity of this powder, which the patentee calls meteoric powder is obtained,

Take 24 pounds of blistered or any other steel,
8 ounces of fine meteoric powder,
6 ounces of pulverized chromate of iron,
1 ounce of wood charcoal,
2 ounces of quick lime,
2 ounces of porcelain earth,

and subject the whole in the ordinary crucible, to the requisite heat. The above proportions produce steel of excellent quality which may be heated and drawn out in the usual manner. When its surface is polished and treated with a mixture of one part of nitric acid and twenty parts of acetic acid, it presents a beautiful damasked appearance. As soon as the acid has taken thorough effect, the piece is to be carefully washed.

Bull. d'encour.

Process for rendering wool, dyed or not dyed, fit for spinning without oiling.
By M. Pimont.

Boil water, pure or alkaline, in a strong digester provided with a safety valve, and conduct the steam through a copper tube into a tight metallic vessel containing the wool to be prepared. The action of the steam, under strong pressure, penetrates the wool, thoroughly extends it, and expands it so that it can be spun without oil. Ibid.

Fabrication of a Black Enamel, known under the name of Nielle. By M. M. Wagner and Mention.

This is composed of an ounce of silver, two ounces and a quarter of copper, one ounce and five eighths of lead, half an ounce of borax, and twelve ounces of sulphur.

The sulphur is put into a retort and the silver and copper into a crucible; when the metals are melted add the lead, and pour the whole into the retort, and close it tightly to prevent the inflammation of the sulphur. Before the mixture is calcined, add the borax, to refine and purify the mixture, and then continue the calcination, until neither flame nor smoke appears in the neck of the retort. Pour the contents into an iron pot. This alloy is hard enough to receive a polish like silver and supple enough not to scale. After pulverizing it, wash it in filtered water, mixed with sufficient quantity of sal ammoniac to acidulate the water, which separates all impurity from the alloy;—pour off the fluid, and wash the material again with clear water, to which a little gum arabic has been added.

When the surface to be enameled has been well prepared, apply the nielle by means of a spatula, the gum arabic attaches it without rubbing in the lines made by the graver. Place the article thus covered in a muffle in the enamelling furnace and let it remain until the Nielle is melted. Then

withdraw it from the muffle, and if the enamel is melted clear and without blisters, polish it by the means and processes used for polishing silver.

Ibid.

New mode of preparing bicarbonate of potash. By Wohler.

Carbonate of potash, either dry or in solution, as is well known, absorbs the second atom of carbonic acid, which is necessary to its transformation to the bicarbonate, very slowly. Wohler found that the porous state of charcoal mingled with this salt, facilitated, in an extraordinary manner, the formation of bicarbonate. The following method is adopted. Crude tartar is carbonized in a covered crucible,—the carbonized mass is slightly moistened with water, placed in a suitable vessel, and carbonic acid gas is passed through it. The gas is absorbed with such rapidity that the mass grows so warm as to make it necessary to surround the vessel with cold water to prevent the decomposition of the bicarbonate formed. The moment of saturation is known by the diminution of temperature. The material is then lixiviated with the least possible quantity of water of 90° or 100° Fahr. and as the filtered solution cools, the greater part of the bicarbonate of potash is deposited in fine crystals.

Jour. de Pharm.

Notice of a New Process for making Bricks, Tiles, &c. Invented by M. Terrasson.

After remarking upon the properties necessary in a machine that shall completely fulfil the objects of an artificial brick maker, the difficulties to be surmounted in such an invention, especially that which arises from the adhesion of the clay to the mould, and the failure, wholly or in part, of all former contrivances for this purpose, the inventor thus describes his plan:

This machine is divided into two parts.

1. Machine for kneading the clay.
2. Machine for moulding and transporting the bricks to the area, or yard.

The same motive power may accomplish both objects.

Machine for Kneading.—Horse or water power, &c., may be used at pleasure. That which I use at Teil is moved by two horses. The yard is on the side of an argillaceous hill. Two large sheds are erected, one of which is two stories high; the upper serving for the horse floor, the large wheel, and the several connecting parts. The ground floor below contains the moulding and transporting machine.

The other shed is a drying room and store house; it is situated so as to serve as a place of discharge by the shortest way possible.

The hill forms a slightly inclined plane; it furnishes the earth, and from its position facilitates the transportation of the clay.

Machine for Kneading and drawing out the Clay.—Two horses attached to the two arms of a lever, turn a large wheel connected with a trundle, which impels a vertical shaft working in a cylinder or field vat. This shaft is furnished with spiral cutters;—the moistened earth is put into the vat, the cutters in turning, knead it, divide it, and force it, by its own weight and the impulsion of the screw, which operates like the screw of Archimedes, excepting that it reverses the motion. The clay arrives at the bottom of the vat exceedingly well prepared, and then passes through a hole,

round or square, which may be enlarged at pleasure by means of a screw which presses against a slide. We thus obtain a roll or fillet of clay of any desired dimensions.

Machine for Moulding and Transporting the Bricks.—This machine, which gears in to the one above, is placed below the vat in such a manner that the clay, already formed of a due calibre, enters the mould, which is nothing more than a chaplet or hollow frame, moving horizontally, with an adjusted velocity, and turning upon and around cylinders. A large cylinder is placed over the mould, and another below, forming a rolling press which flattens and compresses the clay.

After having passed with the mould under this large cylinder, the clay is perfectly level or even; a boy having previously placed boards in the mould, and upon these boards the bricks are made. The frame returns empty, the boards continue their horizontal course, bringing a fillet of clay well pressed and levelled; two wires, stretched by a weight, and placed on each side of the board, free the clay, and remove all the roughness which, in being stripped, the mould might have left on the fillet.

The boards continue their horizontal course, being urged forward by those which the child continues to place in the mould; they arrive at a point immediately under one end of a balance weight (bascule) formed of a frame, across which wires are stretched, and which, as the weight falls, cut off, in the twinkling of an eye, ten or twelve bricks. The machine stops an instant to give time for this important operation, which may be repeated five times in a minute. A clock bell gives notice when the stroke is given. When the bricks are cut off, and the balance weight rises, the chaplet continues its motion, and two boys take hold of the board.

By means of a long file of cylinders upon a slightly inclined plane, the boards are carried to any desired distance without labour, being hurried down like wagons on an inclined railroad.

I have stated that five strokes of the balance weight may be given per minute, making fifty bricks of large size. By dividing them, 100 of less size would be made;—indeed, if the children could take them off, 150 might be made, a result which, however incredible, is nevertheless true, as I have proved before the authorities of the country, who were quite incredulous before they saw it. I have even gained bets upon it.

I have hitherto employed only horse power, but there would be great advantage in using steam, wind, and especially water; the velocity of the shaft being more regular and rapid with a water fall, and with a greater force than two horses, the kneading and other operations would be better performed.

By a similar arrangement, tiles are made, earthen water pipes may be moulded, concave bricks for vaults, and in fact all sorts of bricks, refractory and others.

Receuil Industriell.

Progress of Physical Science.

Minimum Density of Liquids. By C. Despretz.

Two memoirs, one on the maximum density of pure water and the other on that of saline solutions, were read before the *Academie des Sciences* and an account of them given in the *Comptes Rendus de l'Academie*, by Gay

Lussac, Arago and Becquerel. This has been translated by W. Francis. G.

After noticing and trying several methods, the author states, "the process which appeared to me to be the most suitable, was to compare the progress of a water thermometer with a mercurial thermometer. For this purpose I constructed six water and four mercury thermometers. All these instruments were divided into parts of equal volume. In order to get rid of the error which arises from the conical form of the tubes, I disposed them so that the variation in the size of the diameter took the one direction and the other alternately. In the first experiments the instruments were placed in the midst of a liquid which was gradually made cold; and after it had passed the apparent maximum, the apparatus was left to the calorific influence of the surrounding bodies; it then became warm, and arrived at the point of departure. By performing the experiment so that the heating kept equal pace with the refrigeration, the error occasioned by the want of coincidence between the water thermometer and the mercury thermometer was avoided; the first being always behind the second. I also lessened very much this cause of error by taking the mean of the results obtained; nevertheless I preferred observing in the statical condition.

After various essays, which need not be enumerated, I adopted the following apparatus.

It consists of a cylindrical copper vessel, similar to a large eprouvette. In this vessel two water thermometers and three mercury thermometers are suspended, the two first alternating with the latter; all the reservoirs are at the same height; the vessel is corked so as to hinder the access of external air. It is then placed in a large earthen vessel filled with a mixture at various temperatures, from + 16° Cent. to the freezing of the water, which takes place at times at —5°, at times at —10°. sometimes at —15°, and even at —20° Cent. We should remember that Gay-Lussac had previously observed water to remain in a liquid state —12° Cent.

Each experiment lasted from eight to ten hours, during which from eight to ten numbers were taken.

The results obtained with the water thermometers, were as follows:

Seven experiments	with	one tube	9°.39C.
Seven	do.	another	4. 02
Two	do.	a third	4. 01
Two	do.	a fourth	3. 96.

The mean from these eighteen experiments is 4° C., which agrees within two hundredths with the result of the former process.

Before and after each experiment the zero of the thermometer was examined. This verification is absolutely necessary, because the zeros of thermometers, even of those which have been constructed for a long time, differ when these instruments are kept for some time at a low or high temperature. We shall have occasion to return to this important fact on another occasion.

So many contradictory results have been obtained on the subject of the maximum of density of pure water, that it is quite unnecessary to mention here in what these experiments may be regarded as more nearly approaching to the truth. They occupied me for a year. I constructed and graduated all the instruments myself. The weighings were performed with the greatest care. Fearful of partial errors, all the results were represented by drawings on a very large scale. I lay before the Academy a few only of the numbers and curves. Although we cannot answer for the hundredth

part of a degree, considering the extreme mobility of glass instruments, we yet remark that the difference of the single results with 4°, a difference which in general has amounted to some hundredths, never surpassed 0°.1, and that the two processes, which have not the least relation with one another, have furnished sensibly the same result. Nevertheless, on account of the importance of the subject, I shall have the honour in a short time of laying before the Academy some experiments made by a process not yet described, and employed at very low temperatures.

This memoir closes with a table of the dilatation of water from degree to degree, from the maximum to the boiling point, and from the maximum to —13° Cent. The dilatation is a little stronger below than above the maximum.

This dilatation amounts $\frac{45}{1000}$ from 4° to 100°.

Various points of the scale have been verified by fixed temperatures, as that of æther, alcohol, &c. The curve of dilatation is almost a parabola for a very considerable space on the scale.

Extract from the Second Memoir.

The question respecting the maximum of density of saline solutions, immediately connected with the researches relative to the temperature of the sea at various depths, has been for a long time agitated among natural philosophers, who, however, are far from agreeing with each other on this subject; thus, as Ermann remarks, while Rumford, Marcet, and Berzelius think that salt water has no maximum, Gay-Lussac, Scoresby, and Sabine, guided by analogy, profess quite a contrary opinion.*

Of the four methods described in my paper on the maximum of pure water, says M. Despretz, one only is applicable to aqueous solutions. It is that in which the course of a water thermometer is compared with that of a mercury thermometer. In the experiments with saline solutions, as in those of pure water, four thermometers filled with saline solutions and four with mercury were immersed in a large vessel, the temperature of which was gradually lowered to six or seven points, which I sought to render fixed. In order to avoid the influence of the warming or cooling of the vessel, thermometers containing mercury and saline solutions were taken alternately. A curve was traced with the apparent contractions and expansions, to which was drawn a tangent parallel to the line of expansion of the glass. The tangential point gave the temperature of the maximum, *i, e,* the point where the expansion is equal to the contraction of the glass, which is evidently the point where the absolute dilatation of this solution is zero. This is the transition of the contraction into the expansion by cold.

M. Despretz did not find a single aqueous solution which did not show a maximum either above or below the freezing point. The solutions which contain 1 to 3 centimetres of foreign matter are in the first predicament; those containing more, in the latter.

Every one can demonstrate the existence of a maximum for any aqueous solution whatever; for this purpose it is only necessary to construct a thermometer with the solution, and to lower the temperature rather slowly: the liquid is seen to contract down to a certain point, and then by a continued refrigeration regularly to expand.

These experiments being very long and laborious, after having proved

*Captain Sabine's remarks on this subject will be found in Phil. Mag. First Series, vol. lxiii. p. 70.—Edit.

the existence of a maximum for any aqueous solution, the author contented himself with extending these researches to eleven different substances: sea water, chloride of sodium, chloride of calcium, carbonate of potash, carbonate of soda, sulphate of potash, sulphate of soda, sulphate of copper, and alcohol.

With the exception of sea water, every substance was dissolved in pure water in seven different proportions. These ten substances therefore give seventy solutions. The nature of the substances was varied, in order to follow the general course of the phenomenon. Among them were deliquescents, efflorescents, bodies which are not affected by the air; some very soluble, others of little solubility.

We will begin with mentioning the results which relate to sea water. I first operated, says M. Despretz, with an artificially formed sea water according to Marcet's analysis; but M. Arago, to whom I mentioned my first experiments, had the kindness to offer me some sea-water collected by M. Freycinet in the Southern Ocean. This water weighed at 20° 1.0273. The mean from twelve experiments gave—2°.55 for the temperature of the freezing point in a state of agitation; at the instant of freezing the thermometer returned to —1°.84 of density. This fluid has its maximum density at —3°.67. This is the mean deduced from five experiments with three different tubes. One tube gave twice —3°·69; a second —3°.60 and —3°.59; a third —3°.77. We now see the reason why Marcet and Ermann did not discover any maximum density in sea water, because they searched for it above the freezing point, while it is situated at more than one degree below.

The solution of the question relative to sea water sufficed for the purposes of physical geography; but the history of corpuscular properties required a more general solution. It was necessary to extend these experiments to a certain number of aqueous solutions in order to discover the course which the maximum takes as the addition of foreign matter lowers it.

For this purpose I dissolved several quantities of foreign matter in the proportions 1, 2, 4, 6, 12, and 24. Each of the substances was employed in a pure state, which it is now very easy to ensure. The chloride of sodium, the chloride of calcium, the carbonate of potash and that of soda were melted. The carbonate of potash was obtained by calcining pure and crystalized bicarbonate. The sulphate of copper was employed crystallized. Water not being an essential part of this salt, it was subtracted; while the pure hydrate of potash, concentrated sulphuric acid and absolute alcohol, (water being in certain respects essential to their composition, since heat alone does not expel it,) were considered as anhydrous bodies. We will mention some of the results obtained:

Sea Salt.

0.009123 of salt····	freezing point*	—1°.21,	Max.	+1°.19	Cent.
0.0246	"	"	—2 ·24	"	—1 .69	"
0.0371	"	"	—2 .77	"	—4 .75	"
0.0741	"	"	—5 .10	"	—16 .00	"

*The temperatures are those marked by the thermometer at the moment when the liquid is on the point of freezing. The temperatures indicating the actual freezing, i. e. which are for the solutions what zero is for pure water, are not so low.

Chloride of Calcium.

0.0371 of salt	freezing point	—3°.92,	Max.	—2°.43Cent.
0.0741	"	—5°.28	"	10.43 "

This sinking of the maximum, says the author, cannot be the consequence of a partial freezing of the liquid mass, since the curve, representing the expansions above and below the maximum, is quite regular, as the drawings which I now lay before the Academy will show; the freezing of the smallest part would determine, in the curve, points which by geometricians are denominated *singular*. Besides, this partial freezing could scarcely take place without causing the freezing of almost the entire mass. The coincidence also which exists between the experiments performed on the same solution, but with different tubes, excludes all idea of freezing. Thus for the solution of sea salt at 0°.0371, one tube gave —4°.80, —4°.73, —4°.76, the mean of which is —4°.76. A second tube gave —4°,73, —4°.72, —4°.77, the mean of which is —4°.74; which differs from the first only by two hundredths.

We conceive that there does not always exist the same agreement in the partial experiments: many however exhibit but a small difference.

In comparing the various experiments, we see that it is neither the more soluble salts, nor the salts which most retard the freezing point, that lower the maximum most; for instance, the chloride of calcium lowers the maximum much less than sea salt; the sulphate of potash less than the sulphate of soda. This result is obtained whatever may be the degree of concentration of the solutions compared.

The two following results, says Despretz, appear to me to be proved:

1. Sea water, and all aqueous solutions, acid, alcoholic, saline and alkaline, have a maximum of density.

2. This maximum sinks much quicker than the freezing point, the variation of which, as well as that of the density, is nearly proportional to the quantity of matter added to the water.

The point of the maximum remains at first above that of the freezing point; it then reaches it, and finally sinks below it. Even with seven hundredths of salt, acid, or alkali, the maximum may be at 12 degrees below the freezing point, so that it is impossible to discover it except by exposing the fluid solution in narrow tubes to temperatures far below that point.

Lond. & Edin. Philos. Mag.

A Few Words on Astronomy.

If England may be permitted to cast a proud eye upon the period in which Flamsted, and Halley, and Newton flourished, she cannot but contemplate with the bitterest dejection, that which succeeded it. As if Providence had decreed that there should be a balance in the glory as well as in the power of nations, no British name has been allowed to share in the intellectual triumphs which illustrated the middle and the close of the eighteenth century. Truth and justice demand from us this afflicting acknowledgment, while they award to Clairaut, Euler, D'Alembert, Lagrange, and Laplace, the high honor of having completed the theory of the system of the world.

The problem of two bodies, or the determination of the motions of one planet revolving round another, had received from Newton the most per-

fect solution. He had even shown that the problem of three bodies, in which the action of a disturbing planet is introduced, could be resolved by the principles which he had established; and in the case of the lunar irregularities, he had succeeded in explaining no fewer than *five* of the most important. At this point, however, the power of analysis failed, and it was left to a succeeding age to complete the noble edifice which he had founded. The results of the labours to which we allude are developed in the *Mécanique Céleste* of Laplace, a work which ranks next to the Principia; but it would exceed our limits were we to assign to each of the astronomers we have named their respective claims to immortality. By the improvements they have made in the analytical art, they have solved the problem of three bodies, and have computed, with accuracy almost miraculous, the various disturbances which affect the motions of the principal planets. But though all the bodies of the system thus exercise over each other a reciprocal influence, yet it has been proved by Lagrange, that the resulting irregularities are all periodical, and that while the form and position of their orbits are ever changing, their mean motions and mean distances from the sun are subject to no variation. Amid the actions and re-actions of our system, therefore, the general harmony is never broken, and from the arrangements of this celestial mechanism, disorder and decay have been forever excluded. What a sublime and instructive picture is thus presented to man!—while he and every thing around him bears the impress of his fleeting nature,—while even the solid globe on which he treads is rent by convulsions, and agitated in the conflict of its elements, yet does the general system stand unshaken amid the oscillations of its parts, and thus testify to each generation, as it comes, the wisdom and the power with which its great architect has provided for the stability of his material throne.

But though the spirit of English science had thus been slumbering amid the intrigues of faction, and the apathy of shortlived and unenlightening administrations, the exertions of individual genius were preparing in secret for new achievements. The invention of the achromatic telescope by Dolland, and the improvement of the reflectors by Short and Mudge, had armed the observer for the great object of sidereal astronomy—for examining the phenomena and condition of the stars, and the structure of the groups and systems which the telescope descried in the immensity of space. In this period, doubtless the most brilliant in the annals of discovery, the name of Herschel stands in proud pre-eminence, as the founder, and the most successful cultivator, of sidereal astronomy; and when we add the name of his accomplished son, of Dr. Brinkley, (bishop of Cloyne,) of Sir James South, and of Mr. Struve, we complete the list of the great men who have immortalized themselves in this difficult and boundless field of inquiry.

Before we proceed to give an account of their labours, it is necessary that the reader should have some idea of the distance and magnitudes of the bodies which are to come under his consideration. That the nearest of the fixed stars are not placed at immeasurable distances, has been fully established by the numerous and ably conducted observations of the Bishop of Cloyne. This distinguished astronomer has found that the star *α Lyræ* has a paralyx of 1″. 1, or, what is the same thing, that the radius of the earth's annual orbit, would, if seen from that star, subtend an angle of 1′. 1: hence it follows, that its distance is 20.159.665.000,000 miles, or twenty billions of miles. Sir William Herschel, from repeated measurements, considers the diameter of *α Lyræ* as three tenths of a second, and consequently,

its diameter must be *three thousand times* greater than that of our sun, or 2,669,000,000 miles, or *three-fourths* of the size of the whole solar system, as circumscribed by the orbit of the Georgium Sidus. This extraordinary result does not entirely accord with a curious calculation of the Marquis Laplace, that a luminous star, of the same density as the earth, and whose diameter is two hundred and fifty times that of the sun, would exercise such an attraction over the rays which issued from it, that they could not arrive at the earth; the consequence of which would be, that the largest luminous bodies in the universe would, on this account, be invisible. But however this may be, it cannot be doubted that the scale of distance and magnitude for the fixed stars cannot be greatly different from that which we have stated.

It was to regions so remote, and to bodies so vast, that Sir William Herschel directed his powerful telescopes, after he had extended the limits of our own system, by the discovery of *one* primary and *eight* secondary planets. Professor Kant and the celebrated Lambert had suggested the hypothesis, that all the bodies in the universe were collected into nebulæ, and that all the insulated and scattered stars formed part of the nebula to which our own system belonged. Pursuing this happy thought, Sir William Herschel examined no fewer than 2,500 nebulæ, and he was led to the opinion, that the galaxy, or milky way, was the projection of our own nebula in the sky, and by *gauging* the heavens, or counting the number of stars which occur in the same space in different directions, he was enabled to determine the probable form of the nebula itself, and the probable position of the solar system within it. But while this idea impresses us with its grandeur, it at the same time furnishes us with a scale for estimating the immensity of nature. If all the separate stars which the most powerful telescope can descry, are only part of our own nebula, what must we think of the millions of nebulæ, some of which exhibit, by their proximity, the individual stars of which they are composed; while others, as they recede from our failing sight, display only in the best instruments a continuous and unbroken light, in which the spaces between the stars can no longer be seen? From the systems which roll within these groups of worlds, a new firmament of stars will be seen, and each system will have its milky way, exhibiting the projection of its nebula, varying in form and in lustre with its locality within the group. It is in vain to pursue ideas so vast and overwhelming; it is enough that the mind tries its strength, and stands self-convicted of its weakness.

Let us, therefore, turn our attention to nearer objects—to our own nebula, and the stars which compose it. Not content with determining the probable position of the solar system within the nebula of the milky way, Sir William Herschel conceived the idea of ascertaining whether that system was stationary, or movable. By a comparison of the proper motions of the fixed stars, he determined that the solar system was advancing towards the constellation Hercules, and that, if it were viewed from one of the nearest of the fixed stars, the sun would appear to describe an arch of about *one second.* In reasoning respecting the insulated stars, which belong to what we may now call the *solar nebulæ*, he justly conceived that those which were double must form a *binary system*, or systems, in which the two stars revolve round their common centre of gravity. We have said in many cases, because there can be no doubt that two stars may often form a double star, when they have no connexion with each other, but that of similarity of direction. The same conception is applicable to more complicated systems,

and he has shown how three or more stars may be permanently connected, by revolving in proper orbits round a common centre.

These views, at first entirely speculative, received from subsequent and long-continued observation a very remarkable confirmation. If we suppose a line to join the centres of the two stars which compose a double-star, then if the two stars have no relative motion, this line must form an invariable angle with the line or direction of their daily motion. By means of an ingenious position micrometer, Sir William Herschel determined this angle, (called the *angle of position*,) for seven hundred and two stars, between 1778 and 1784. After a lapse of twenty years, he repeated his observations on the same stars, between 1800 and 1805, and he had the satisfaction of finding, that in more than fifty double stars, there had been a decided change either in their distance, or in the angle of position. In this way he discovered that one of the stars of *Castor* revolved round the other in three hundred and forty-two years; and that the small star of γ *Leonis* performed its circuit in 1200 years, and that of ε *Bootis* in 1681 years, that of δ *Serpentis* in 375, and that γ *Virginis* in 708 years.

By this great discovery, the greatest, unquestionably, in the history of astronomy, the existence of systems among the fixed stars was completely established; but so far did Sir William Herschel's labours transcend those of the age in which he lived, that no attempt was made to repeat and to extend them. They were scarcely admitted into any astronomical work; they were ridiculed by men whose reputation had been eclipsed by his own; and they were received with a sort of incredulous wonder, even by the most ardent lovers of astronomy. The progress of knowledge and of discovery had paved the way not only for the highest achievements of Newton and Laplace, but also for their immediate reception among philosophers; and had these great men never lived, science would, in a very few years, have received from other minds the same splendid accession. The discoveries of Herschel, on the contrary, exhibited no continuity with those of his predecessors. Before his day, sidereal astronomy had no existence; nor had the wildness of speculation ventured even to foreshadow its wonders. Entrenched in the remoteness of space, among spheres which no telescope but his could descry, her walls were unscaled, and her outworks even unapproached. His genius, however, enabled him to surmount barriers hitherto impregnable, and conducted him in triumph into the very stronghold of her mysteries. The cessation of such gigantic labours would have been afflicting to science, had not that same wisdom which provided for the continuity of his name, provided also for the continuity of his labours.

In the year 1816, four years before the death of his venerable father, Sir John Herschel had begun a re-examination of all the double and triple stars, and had made some progress in it. The same idea had occurred to Sir James South, one of the most able and enterprising astronomers of the present day, and it was agreed that they should undertake the work in concert. They accordingly began in March 1821, and continuing their observations in 1822 and 1823, they were enabled to communicate to the Royal Society in January, 1824, the position and apparent distances of 380 double and triple stars, the result of above 10,000 individual measurements.* The instruments which they employed were two achromatic telescopes mounted equatorially: the object-glass of the smallest had an aperture of three inches and three quarters, and a focal length of five feet, and was made by the

*This Memoir was honoured with the astronomical prize of the French Academy of Sciences.

late P. and J. Dolland. The power usually employed was 133, but powers of 68, 116, 240, 303, and 381 were sometimes used. The largest telescope was *seven* feet in focal length, with an aperture of *five* inches, and is supposed to be the best Tulley ever executed. The power commonly employed was 179, though 105, 273, and sometimes 600 were used.

No sooner had Sir James South completed his share in this great work, than he began another series of observations of equal difficulty and importance. They were made principally at Passey, near Paris, with the instruments above mentioned; and in November, 1825, he communicated to the Royal Society the apparent distances and positions of four hundred and fifty-eight double stars, of which one hundred and sixty had never before been observed.

While these observations were going on in England, an able continental astronomer, M. Struve, director of the Imperial Observatory of Dorpat, in Livonia, had occupied himself with the same subject; for such was his assiduity and zeal, that in four years he completed his *Catalogus Novus Stellarum Duplicium et Multiplicium*, containing no fewer than three thousand and sixty-three stars.* These observations were chiefly made with a telescope by Frauenhofer, which the Emperor of Russia had presented to the observatory of Dorpat. This magnificent instrument has a focal length of thirteen feet, and an aperture of nine inches, and cost thirteen hundred pounds. The king of Bavaria followed this noble example by ordering a still finer instrument for the same purpose; and the king of France, with a liberality still more patriotic, has had executed in his own capital an achromatic telescope, surpassing them all in magnitude and power. What a mist is it to English science, that the name of the most accomplished prince who has yet occupied the throne of Charles I. does not appear in the list of sovereigns who have thus been rivalling each other in the patronage of astronomy! What a mortification to English feeling, that the subject of sidereal astronomy created by the munificence of George III. should thus be transferred to the patronage of foreign monarchs.

In taking a general view of the labours of Sir John Herschel, and Sir James South, it appears that there are *sixteen* binary systems of stars perfectly established, and at least *fourteen* of which the annual motion is not exactly determined.

The established binary systems, with their periods and annual motions, are given in the following table. The signs ÷ and — indicate the different directions of the motion.

Names of stars.	Periods. Years.	Annual motion.
ξ Ursae Majoris	51	—7°.02
70 p Ophiuchi	53	—6.81
σ Coronæ Borealis	169	—2.13
Castor	370	—0.971
61 Cygni	493	÷0.73
δ Serpentis	496	—0.726
γ Virginis	540	—0.667
s f μ Bootis	623	—0.58
μ Draconis	623	—0.58
12 Lyncis	646	—0.56

*The labours of this indefatigable astronomer have been rewarded by the Royal Society of London with one of their gold medals.

Names of stars.	Periods. Years.	Annual motion.
η Cassiopeiæ	700	—0°.513
49 Serpentis	706	+10.5
Aquarii	804	—0.448
ε Bootis	822	+0.438
5 Lyræ	1108	—0.325
γ Leonis	1200	+0.30

Of these stars, ξ Ursæ Majoris possesses a very peculiar character, as *the two stars revolve round their common centre of gravity with a motion so rapid as to admit of being traced and measured from month to month.*

Another object of very peculiar interest to astronomers is ζ *Herculis*, which both Sir John Herschel and Sir James South have found to be *single*, with the best telescopes. In July, 1782, however, it was a distinct double star, the greater being of a beautiful bluish white, and the lesser of a fine ash colour. In 1782, Sir William Herschel found the interval between the two stars to be one half the diameter of the smaller one. In 1795, he could with difficulty perceive the small star. In 1802, he could no longer perceive it; but in a very clear night, the apparent disc of ζ *Herculis* seemed to be lengthened in one direction. In 1803, with a power of 2140, he found the disc a little distorted, but he was convinced that about three eighths of the apparent diameter of the small star was wanting to make the occultation of it complete. The Dorpat telescope has since separated these two stars.

It is scarcely possible, we think, to peruse the preceding details concerning the history and present advanced state of astronomy, brief and imperfect as they are, without looking forward with the most intense interest to the future progress of science. Even within our own system much remains to be investigated. The nature of the sun, and the constitution of its surface in relation to the more or less copious discharge of light and heat; the physical condition of the moon, which may yet exhibit among her mountains the works of living agents; the theory of four new planetary fragments, which hold out to physical astronomy some of its most perplexing problems; the forms, rotations, and the densities of most of the secondary planets, are all subjects fraught with the deepest interest to astronomers. The comets, too, those illusory bodies of which we scarcely know whence they come, or whither they go, have now been brought within the grasp of regular observation. The discovery of two comets with short periods, one of three and one-third years, revolving within the orbit of Jupiter, and the other with a period of five years, revolving within the orbit of Saturn, enables us to observe them period after period, and to study their motions as well as their physical constitution. But how shall we describe the future prospects of sidereal astronomy? In our own nebula we may trace the motion of the solar system round some distant centre; we may discover the causes which produce the phenomena of variable stars; and we may witness the extension of the law of gravity to the movements of binary, and even more complicated, systems. Among the nebulæ beyond our own, discoveries still more extraordinary await us. May we not see even the operations of those powerful agents by which whole systems are formed, and of those still more tremendous forces by which other systems are destroyed? In the changes of particular nebulæ, and in the condensation of nebulous matter into lucid centres, and even into central stars, we recognize the first of these agents; and in the sudden disappearance of the most brilliant stars, we have some indication of the second. Thus may we study, in these distant regions, the

active operations of creative power; and thus, in relation to the past and the future in our own globe, may we be permitted to witness the types of those great events which are necessarily excluded from the short span of our existence.

Nautical Magazine.

On the Results of Experiments made on the Weight, Height, and Strength of above 800 *Individuals. By* James D. Forbes, Esq., F. R. SS. L & E., Professor of Natural Philosophy in the University of Edinburgh.*

The interesting and remarkable experiments published by M. Quetelet of Brussels, on various points of physical developments in man, under a variety of circumstances, as to climate, station, age and sex, induced me to take the opportunity which my professional position presented of obtaining the measure of physical development as to the weight, height and strength of natives of Scotland between the ages of 14 and 25, students of our University.

In the prosecution of this plan, separate lists were kept of persons not born in Scotland, and of these, the English and Irish lists have likewise been subjected to calculation. Though of these the numbers are comparatively small, the results present some pretty decisive characters. These experiments were continued during two winters (1834–5, 1835–6;) every experiment was made by myself, and noted down by myself. The weights were ascertained by Marriot's spring balance, which was verified from time to time, and found to have undergone no change in its elasticity. The weight of clothes is included.† The heights are in English inches, shoes included. For the measure of strength, Regnier's dynamometer was employed, and these experiments were somewhat less satisfactory than the others. The error of the instrument had been ascertained before the commencement of the experiments, and was found to be pretty constant throughout the scale. But after the experiments were finished, this was by no means the case, the error having become variable owing to the interfering action of a small spring employed to bring the index to zero. As this, however, only affects the absolute results, (or, at least, its relative influence is trifling,) I have contented myself with applying an interpolated correction deduced from the mean of the errors before and after, which cannot differ much from the truth. But the instrumental errors are not the only ones to be contended with. To avoid errors in the *use* of the dynamometer requires vigilant superintendence on the part of the observer; and as the first pull is generally, (though not always,) greater than the second or third, this also must be allowed for. I have invariably repeated the experiment three times, and often much more frequently. When extraordinary cases have occurred, I have taken the precaution of observing at distinct intervals of time.

In ascertaining the mean results, the following method has been adopted: the natives of each country were separated, and each class divided, according to age, into twelve sets, from 14 to 25, the greatest number being of the age of 18 years. The mean weight, height, and strength, for each year, was computed, and the result projected upon ruled paper.

*Read to the Royal Society of Edinburgh: and communicated by the author.

†According to Quetelet, this amounts to 1–18th of the weight.

Curves were drawn through the points thus projected, in such a way as to represent most satisfactorily the whole observations. These curves, with the determining points, are now exhibited to the Society. It is proper to add that the ages registered being the ages *at last birthday*, the weight, &c., registered, is not that due to the age noted, but at a mean to an age half a year later. Thus all the persons who were 20 last birthday are *between* the ages of 20 and 21, or 20½ at a mean. This has been attended to in making the projections.

Besides the English, Scotch and Irish curves, I have exhibited those of the Belgian development, from M. Quetelet's experiments, reduced to English measures. The thickness of the shoes not being included in these experiments, half an inch (perhaps too little) has been added to make them comparable with the others. It is important to add that M. Quetelet's experiments here quoted, as well as my own, were made upon persons in the higher ranks of life, in both cases, in fact, upon persons having the benefit of academical instruction.

The number of persons examined by me in the two winters before stated was thus divided: Scotchmen, 523; Englishmen, 178; Irishmen, 72; from the Colonies, &c., 56; total, 829. I was careful to obtain a fair average of persons of all degrees of height and strength, in which respect the Scotch average is more unexceptionable than the others. There is always a tendency in such cases to get too high a development, because diminutive persons are the least likely voluntarily to come forward. An example of this is found in the mean height obtained by M. Quetelet, from a register of 80 individuals at Cambridge between the ages of 18 and 23, giving a mean of 69.6 inches, instead of 68.7 as my experiments indicate.

The numerical results derived from the graphical process before described are given at the close of the paper, and seem to warrant the following conclusions:

1. That in respect of weight, height, and strength, there is a general coincidence in the form of the curves with those of M. Quetelet.

2. The British curves seem to have more curvature for the earlier years, (14 to 17,) or the progress to maturity is then more rapid, and somewhat slower afterwards. If we may depend upon the English curves, this is more strikingly the case in natives of that country than of Scotland, at least in point of weight and strength.

3. The tables incontestibly prove the superior development of natives of this country over Belgians. The difference is greatest in strength, (one fifth of the whole,) and least in weight.

4. In comparing natives of England, Scotland, and Ireland, more doubt arises, owing to the difference in the number of experiments; those for Ireland are confessedly most imperfect. Yet I conceive that the coincident results in the three tables entitle us to conclude that the Irish are more developed than the Scotch at a given age, and the English less. Some qualification is, however, due, in consequence of the remark, (2;) for in the earlier years, (14—17,) it would even appear that the English so far get the start of the Scotch, as not only relatively, but also absolutely, to surpass them (in strength and weight;) but between 17 and 19 they lose this advantage. I am disposed to think that this appearance of a result is not accidental.

5. The maximum height seems scarcely to be attained even at the

age of 25. This agrees with M. Quetelet's observatisons. Both strength and weight are rapidly increasing at that age.

6. In the given period of life, (14—29,) all the developments continue to increase; and all move slowly from the commencement to the end of that period. Hence the curves are convex upwards. [This is not the case below the age of 14, for weight and strength. Quetelet.]

TABLES.

Weights in Pounds (including clothes.)[1]

Age.	English.	Scotch.	Irish.	Belgians.
15	114.5	112	....	102
16	127	125.5	129	117.5
17	133.5	133.5	136	127
18	138	139	141.5	134
19	141	143	145.5	139.5
20	144	146.5	148	143
21	146	148.5	151	145.5
22	147.5	150	153	147
23	149	151	154	148.5
24	150	152	155	149.5
25	151	152.5	155	150

Heights in inches. Full dimensions (with shoes.)

Age.	English	Scotch.	Irish.	Belgians.
15	64.4	64.7	....	61.8
16	66.5	66.8	....	64.2
17	67.5	67.9	....	66.1
18	68.1	68.5	68.7	67.2
19	68.5	68.9	69.4	67.7
20	68.7	69.1	69.8	67.9
21	68.8	69.2	70.0	68.0
22	68.9	69.2	70.1	68.1
23	68.9	69.3	70.2	68.2
24	68.9	69.3	70.2	68.2
25	68.9	69.3	70.2	68.3

Strength in Pounds.

Age.	English.	Scotch.	Irish.	Belgians.
15	....	208	....	204
16	336	314	....	236
17	352	340	369	260
18	364	360	389	280
19	378	378	404	296
20	385	392	416	310
21	392	402	423	322
22	397	410	427	330
23	401	417	430	335
24	402	421	431	337
25	403	423	432	339

Lond. and Edin. Philos. Mag.

The foregoing results are certainly very interesting and I would respectfully suggest that the Professors at the Medical Schools of Philadelphia, at their next sessions, determine the state of their respective classes on the same points at least, which have received the judicious attention of Professor Forbes. G.

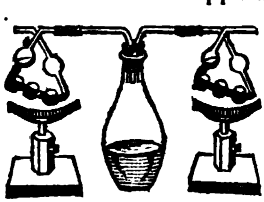
On the Frozen Soil of Siberia. By Professor Baer of St. Petersburgh.

It has long since been ascertained, says M. Baer, that over a great extent of country, the soil of Siberia is never entirely free from ice; during the summer, the surface of the ground is, to a greater or less depth, thawed; but at some distance from the surface, a bottom of perpetual ice is met with. Gmelin the elder, in his travels in Siberia, states that shortly after the foundation of the town Yakutzk (in Lat. 62½° North; Long. 130° East nearly,) at the end of the seventeenth century, the soil of that place was found to be frozen at a depth of 91 feet, and that the people were compelled to give up the design of sinking a well. Many other facts of this description were collected by travellers about the middle of the last century; but these facts seem not to have been generally credited; and even in 1825, Leopold Von Buch, a philosopher whose opinion is of the greatest weight in all questions connected with the physical condition of the globe, rejected these statements as entirely erroneous; yet they have been corroborated in our days by the travels of Erman and Humboldt. Until very lately, nothing was known respecting the thickness of the frozen surface; but within these few years a merchant of the name of Schargin, having attempted to sink a well at Yakutzk, was about to abandon the project in despair of obtaining water, when Admiral Wrangel persuaded him to continue his operations till he had perforated the whole stratum of ice. This he did, and kept a complete journal of his work. The well, or pit, of M. Schargin had been sunk to the depth of 382 feet, and at that distance from the surface, the soil was very loose, and the temperature of the earth ½° Reaumur (31° Fahr.,) but nearer the surface it had been much lower, and had increased as follows: Reaumur, 6° at some feet below the surface; 5° at 77 feet; 4° at 119 feet; 2° at 217 feet; 1½° at 305 feet; ½° at 350; ½° at 382 feet. As the soil had already become loose at 350 feet, and as the aperture of the well was eight feet square, and the work carried on partly during winter, when, of course, the column of cold air must have rushed into the pit and chilled the temperature, it is probable that the spot at which the thermometer marked the freezing point, was at the depth of 350 feet. This immense thickness of ground ice would prove that Siberia must have been for a long period in the same physical condition as it is at present. In the actual state of our information on this subject, it is impossible to determine how widely this layer of ground-ice is spread under the surface of Siberia; yet we know enough to say that it extends over an immense tract of country. Humboldt found the soil frozen at a depth of six feet at Bosgolowsk, near the Ural, in 60° North Lat. Near Beresow, Erman found the temperature of the earth at a depth of 23 feet, still +1°.6, (35½° F.,) but in 1821 a dead body was disinterred, which had been buried 92 years before; the earth around it was frozen, and the body did not shew any signs of decomposition. It has long been known that at Obdorsk, in North Lat. 68°, the ground is always frozen. Near Tobolsk no ice is found in the soil, but as we proceed to the eastward, the ground ice advan-

ces farther north. It is to be hoped that measurements of the temperature will shortly be made at different depths at Yakutzk, and by methods which M. Schargin was unable to employ; also it is desirable to institute an inquiry as to the depth at which the ice annually disappears near the surface, and collect information on the depth of ground ice generally in Siberia. It would also be highly gratifying to me, and extremely interesting to science in general, if the Geographical Society of London would collect information respecting the extent of the layer of ground ice in North America, the thickness which it attains, and how much of it disappears by the summer heat, in those countries over which the factories of the Hudson's Bay Company are disseminated. At the termination of the reading of this paper, an animated discussion took place on the frozen soil of Siberia, in which the members stated their views on the subject. It appears to be generally considered, that the experiment at Yakutzk had not been made with sufficient care, to authorize the belief that the frost penetrates to so great a depth as 350 feet below the surface of the globe; also that the statements of M. Arago and Von Buch, and others in our own country, on the increase of temperature in proportion to the distance from the surface, were fully borne out by the observation of M. Schargin, and almost exactly in the same ratio as hitherto found. Captain Back stated, that in his many years' experience in the cold regions of North America, even in the height of an Arctic summer, he had never found the ground thawed more than four feet below the surface; but that experiments on the subject were much to be desired. Edin. New Philos. Jour.

Notice of the Result of an Experimental Observation made regarding Equivocal Generation. By F. Schulze, Berlin.

Since the question respecting *generatio æquivoca* has attracted the attention of naturalists, the development of living organisms has never been observed in vessels from which all air has been expelled by boiling, and which had been hermetically sealed. The access of air has been regarded as a necessary condition for the primary formation of infusoria from decomposing organic matter, so that the mere circumstance of covering an infusion with a stratum of oil, removed that condition. But the question still remained undecided, If the access of atmospheric air, light, and heat to *infundirten* substances, included of itself all the conditions for the primary formation of animal or vegetable organisms? And in this point of view new direct experiments were considered to be very desirable. The difficulty to be overcome consisted in the necessity of being assured, first, that at the beginning of the experiment there was no animal, or germ, capable of development in the infusion; and secondly, that the air admitted, contained nothing of the kind. For this purpose I constructed the apparatus represented in the margin.



I filled a glass flask half full of distilled water, in which I mixed various animal and vegetable substances; I then closed it with a good cork, through which I passed two glass tubes, bent at right angles, the whole being air tight. It was next placed in a sand bath, and heated until the water boiled violently, and thus all parts reached a temperature of 212° F. While

the watery vapour was escaping by the glass tubes, I fastened at each end an apparatus which chemists employ for collecting carbonic acid; that to the left was filled with concentrated sulphuric acid, and the other with a solution of potash. By means of the boiling heat every thing living, and all germs in the flask or in the tubes, were destroyed, and all access was cut off by the sulphuric acid on the one side, and by the potash on the other. I placed this easily moved apparatus before my window, where it was exposed to the action of light, and also, as I performed my experiments during the summer, to that of heat. At the same time I placed near it an open vessel, with the same substances that had been introduced into the flask, and also after having subjected them to a boiling temperature. In order now to renew constantly the air within the flask, I sucked with my mouth, several times a-day, the open end of the apparatus filled with solution of potash; by which process the air entered my mouth from the flask through the caustic liquid, and the atmospheric air from without entered the flask through the sulphuric acid. The air was of course not at all altered in its composition by passing through the sulphuric acid in the flask, but if sufficient time was allowed for the passage, all the portions of living matter, or of matter capable of becoming animated, were taken up by the sulphuric acid and destroyed. From the 28th May till the beginning of August, I continued uninterruptedly the renewal of the air in the flask, without being able, by the aid of the microscope, to perceive any living animal or vegetable substance, although during the whole of the time I made my observations almost daily on the edge of the liquid; and when at last I separated the different parts of the apparatus, I could not find in the whole liquid the slightest trace of infusoria, of confervæ, or of mould, but all three presented themselves in great abundance a few days after I had left the flask standing open. The vessel which I placed near the apparatus contained on the following day vibriones and monades, to which were soon added larger polygastric infusoria, and afterwards rotaroriæ.

Ed. New Phil. Mag.

Improvements in Magnetical Apparatus. By the Rev. W. Scoresby.

At the meeting of the British Association, held in Bristol, in 1836, the Rev. W. Scoresby made a communication to the Physical Section, on an improved mode of construction in magnetic needles for compasses, &c. by the combination in a parallel series, *not* in contact, of several thin plates of tempered steel. A variation instrument, which he at that time exhibited, constructed on this principle, was stated to have a far greater directive energy than any instrument, of the nature of a compass, previously constructed. Since that period Mr. Scoresby has been pursuing, as opportunity afforded, an extensive series of investigations on the subject; both as to the law of combination in steel plates and bars, and as to the effect of temper, thickness, &c., on the aggregate power; with the view of producing more powerful instruments for determining the delicate variations in, and the actual condition of, the

earth's magnetism; a subject now engaging attention in some of the principal observatories in Europe. The results, which have been successful beyond the objects originally contemplated, have been recently communicated to the Institute of France. One of these results likely to be of much importance in magnetical science, to which it is extensively applicable, is that of producing permanent artificial magnets of almost unlimited power. On the principle of construction of compound magnets hitherto adopted, only a very limited number of bars could be combined with advantage, in consequence of the great deterioration of power occasioned by the condition of violence. Mr. Scoresby found, on combining very superior plates of tempered steel of two feet in length and about $\frac{1}{27}$th of an inch in thickness, that the first six plates received so much power that no additions, however great the number, were capable of producing more, in the aggregate, than about double that power. Aiming, however, to counteract the tendency to such rapid deterioration, Mr. Scoresby made some magnetical combinations of *perfectly hard* steel plates, (which he has a ready method of magnetizing and testing,) by means of which an almost unlimited power can be obtained. Already this combination has been carried, with no inconsiderable augmentation of the aggregate energy to the very last, to the extent of several dozens of hard plates, 15 inches in length, so as to produce, by such combination, a compound magnet of very extraordinary power for its mass. The application of this principle to apparatus for magnetic electricity will obviously be of much advantage for compactness and power; whilst the application of the discovery to variation needles, dipping needles, and, probably, to sea compasses also, promises to be of much importance in experimental science, as well as for practical and economical purposes. Mr. Scoresby's investigations have also led to other practical results, such as the means of testing most rigidly the quality and temper of steel plates, and of bars intended for compound magnets on the ordinary construction, by which the best plates can be selected and the most powerful combinations may be obtained.

Lond. & Edin. Philos. Mag.

Effects of Clearing a Country.

As new facts, proving the influence of clearing a country, in lowering the temperature and diminishing the streams of water, M. Devize de Chabriol communicated to the Academy of Sciences a notice, in which he established that, according to old charters of the 13th and 14th centuries, the slope of the hill Saint Flour was at that time under vine cultivation; he adds that now-a-days its cultivation no longer proceeds. The chesnut, also, has now disappeared from many districts in which it formerly flourished. Hence, numbers of villages which were situated near the summit of the mountains, have been abandoned, and many old springs have also dried up.

Ed. New Phil. Jour.

Simultaneous Meteorology.—No. IV.

TABLE OF HOURLY METEOROLOGICAL OBSERVATIONS, made during the 21st and 22nd Sept., 1837, at Blackheath Road, near Greenwich, about four miles and a half S. E. of London, *by and under the superintendence* of J. H. Belville, in conformity with the Instructions circulated by the South African Literary and Philosophical Institution.

DATE.	HOUR.	Barometer.	THRM. Attac'd.	THRM. In open air.	WIND. Direction.	WIND. Str'gth.	Prop. of Cloud.	STATE OF THE ATMOSPHERE, CLOUDS, &c.
		Eng. In.	F. °	Fah. °				
Thursday, September 21, 1837.	VI. A.M.	29.950	68	51.0	E.	0	5	*Stratus.* Clear in zenith. (The. min. at night, 50.6°.)
	VII.	29.950	68	55.7	E.	0	4	*Stratus* into *Scud.* Sun appears.
	VIII.	29.953	68	57.4	E.	1	9	Sky now covered with fresh *scud* from E.
	IX.	99.958	68	60.0	E.	1	7	*Scud* disperses fast—perfect blue sky.
	X.	29.970	69	62.5	E.	1	3	Clear. A few light *cumuli* scattered to the N.
	XI.	29.972	72	64.0	E.	1	0	Cloudless.
	XII.	29.980	73	65.0	E.	2	0	Ditto.
	I. P.M.	29.980	74	66.0	N.E.	2	1	Ditto.
	II.	29.997	75	95.9	E.	2	0	Ditto.
	III.	29.999	75	65.6	E.	2	0	Ditto.
	IV.	30.000	74	64.0	E.	2	0	Ditto.
	V.	30.018	73	61.9	E.	1	1	A few light masses of *scud* coming up from the E.
	VI.	30.026	71	59.6	E.	1	3	Several groups of low *scud* have passed since the last observation.
	VII.	30.050	70	56.4	E.	1	1	Clouds nearly dispersed. *Dew falls in abundance.*
	VIII.	30.053	69	56.0	E.	0	0	Quite starlight. Cloudless.
	IX.	30.054	69	54.9	E.	0	0	The same. N B. A delicate radiating thermom. on the ground marked 51° at 9 P.M.
	X.	30.056	69	54.0	E.	1	0	The same.
	XI.	30.057	69	53.0	E.	0	0	The same.
	XII.	30.059	69	52.5	E.	0	3	Appearances of fog and mist to southw.
Friday, September 22.	I. A.M.	30.059	69	52.0	E.	0	5	Mist. *Stratus* covers the sky.
	II.	30.058	68	50.6	E.	0	10	Dense dripping mist. Moon invisible.
	III.	30.058	68	52.0	E.	0	10	The same.
	IV.	30.059	68	53.0	E.	0	10	The same. N.B. The *minimum*, by a self-registering therm. 48.9°.
	V.	30.059	68	53.7	E.	0	10	Mist thinner. *Stratus broken in zenith.*
	VI.	20.062	68	54.1	N.E.	0	9	*Stratus* has now become more dense.
	VII.	30.081	68	55.0	E.N.E.	0	7	*Stratus* disperses. Sun shines at intervals.
	VIII.	30.023	68	58.5	E.	1	4	*Scud* moves swiftly from the E.
	IX.	80.103	68	61.0	E.	1	5	No alteration since the last observation.
	X.	30.102	69	62.0	E.	2	5	The same. *A brisk breeze.*
	XI.	30.102	71	63.5	E.N.E.	2	4	*Scud* decidedly receding.
	XII.	30.103	72	64.5	E.N.E.	2	3	Nearly cloudless. Brilliant sunshine.
	I. P.M.	30.100	74	65.3	E.	2	2	The same.
	II.	30.096	74	64.8	E.	2	1	The same.
	III.	30.100	74	64.0	E.	2	1	The same.
	IV.	30.098	73	62.7	E.	2	1	The same.
	V.	30.097	72	61.9	E.	2	0	The same.
	VI.	30.098	71	59.2	E.	2	0	The same.

Notes.—A copious dew before sunrise on 21st. Soon after midnight on the 22nd, a dense fog prevailed for about three hours. The two days nearly clear, with brilliant sunshine, and a brisk breeze from the east. No other modification of cloud than *stratus* and *scud*. A remarkably fine period.

The time was taken from a good clock, keeping mean time. Rate scarcely percep-

Progress of Civil Engineering.

Notice of the life and services of the late M. Sganzin, *Inspector General of Roads and Bridges, and of maritime constructions. Translated from the Annales des Ponts et Chaussées, by* J. Griscom.

Every day sheds some additional light upon the merits of those men who filled high public stations, during the memorable epochs of the Revolution, of the Empire, and of the Restoration, and who have been associated with the vicissitudes and labours of nearly half a century. He who was for a long time the Dean of the Inspectors general of Roads and Bridges,—who devoted forty years of his life to the service of the marine—Joseph Matthew Sganzin,—has just followed to the tomb a Liard, a Cachin, a Bruyere, a Girard, and a Brisson with whom he had honorably shared in a career of usefulness.

He belonged to a family, originally Italian, which removed to France at the conclusion of the wars of Piedmont. He was born at Metz, the 1st of October, 1750.

After completing his studies at the College of Metz, he entered, on the 6th of November 1768, the School of Roads and Bridges, under the direction at that time of the celebrated Peyronnet.

The preparatory education, common to the various public services, since so happily established in the Polytechnic School, did not then exist; and the Special School of that epoch served to complete the scientific studies of the Colleges and to initiate the students in their technical applications.

M. Sganzin, after a seven years novitiate, was appointed assistant engineer on the 1st of April, 1775; a title which corresponded with that of the present ordinary engineer of the second class, of Roads and Bridges.

He made a brilliant entrance upon the active duties of his station, being appointed to lay out and to execute several roads of the greatest importance, through mountainous districts, in the ancient provinces of Rouergue and Quercy; and his labours were so successful and contributed so much to the prosperity of those countries, as to have preserved the memory of Sganzin, with great fidelity among them. The reconstruction of a pier of the old bridge of Cahors, on a foundation of rubble stone mortar, or hydraulic cement (en béton) is also cited as an achievement in one of the most difficult arts of Engineering, and one of the first examples of this kind of foundation.

This success caused M. Sganzin to be appointed on the 1st of August 1785 inspector of Roads and Bridges, a grade since suppressed, and at that time intermediate between a sub-engineer, and an engineer in chief. M.

tible during the observation. Error obtained by observation of the ball drop of the Royal Observatory, Greenwich.

The Barometer has an elevation of 46 feet above *mean high-water mark* of the river Thames, carefully deduced by very accurate barometrical measurement. Makers, Watkins and Hill, London. The index error of scale presumed to be within a *hundredth* or two of the truth. The Thermometer, by Dollond, suspended in open air, at an elevation of 40 feet from the ground, aspect, northerly.

The comparative strength of wind is indicated by the figures thus,—0 means no wind perceptible; 1, very light breeze; 2, strong breeze. In the column headed *Proportion of Cloud*, 0, signifies quite clear; 10, no blue sky visible; 5, sky half covered.

Sganzin was, in that quality, attached to the great works at the port of Havre, under the direction of the late M. Lamblardie who had the principal charge.

A very close intimacy was there formed between these two fellow labourers, increased by the near equality of their ages, by a similarity of tastes, and a community of elevated sentiments.

The several powers which succeeded each other, after the turbulence of the first revolution, appeared to perceive the happy influence, which this intimacy, this identity of views between two able engineers, would have in the public service, and they each sought to turn it to account.

Hence, as soon as Lamblardie, in 1793, had left Havre, where his name will long be attached to the docks and quays which he constructed, he was replaced by M. Sganzin, raised to the rank of Chief Engineer. The latter engaged alone in the work of the great dock of La Barre.

In 1795 Sganzin was called to Paris, at the instance of his former associate, to act as his coadjutor in the council connected with the committee of public works and to take charge of the depot of charts and plans.

Our victorious armies had just penetrated Belgium and Holland, and expelled from thence the Anglo-Russian forces.

The French government charged M. Sganzin and M. Maudar, (chief engineer of Roads and Bridges then in retirement) to explore all the interior and maritime works of Holland, and to study the various systems of execution which had been practised in that country. Unhappily, the valuable collection of designs and notes, which were the fruits of this mission, and which still remains in the hands of the widow of Sganzin, has not been published; the numerous occupations of Sganzin during his active career, always presenting an obstacle to its execution.

He had returned to Paris in 1798 when death, suddenly, and most unexpectedly, deprived him of his friend Lamblardie, in the vigour of age, in the full maturity of his powers, and when the polytechnic school, of which he was one of the founders and professors, and its first director, promised him a noble reward for his labours, by the light and spirit it had begun to diffuse through the nation.

Again, the Directory found it expedient to fill the chasm occasioned by the death of Lamblardie, in the marine service and in the instructions of the polytechnic school, by recalling Sganzin to the fulfillment of these double functions.

He united to this species of inheritance, another still more sacred;—that of becoming voluntarily the adoptive father of the young family which his friend had bequeathed him, and he united forever his lot with the children of Lamblardie, by marrying their mother.

A short time after, in consequence of the descent of the English upon the Belgic coast, and their destruction of the great Dam of Slikens, near Ostend, Sganzin was charged, by a mission extraordinary, to repair this great work, which comprehended two locks for the passage of vessels of different sizes. He succeeded in less than a year in restoring a safe commercial intercourse with a port, important for its facilities in connexion with the channel.

In the following year (1799) Sganzin received a still more important order,—that of organizing the maritime operations and establishment of the New Dock Yards at the port of Antwerp.

The consulship had just been erected on the ruins of the Directory, and the new Ceasar, in his avidity for all kinds of glory, was full of

plans for public monuments, and extensive works for the defence and riches of the nation, which might hand down his name to the latest posterity, as the monuments of ancient Egypt, which he had recently conquered, had been destined to transmit those of their founders.

His fertile genius reorganized the administration of Roads and Bridges, and instituted a council for maritime operations, composed, at first, of three members, and to this service he appointed Sganzin, Cachin and Ferregeau, still continuing their participation in the deliberations of the general assembly of Roads and Bridges, of which the chief engineers at that period formed a constituent part. On entering upon these new duties, M. Sganzin had to remodel the service of the naval depots in the ports placed under his administration.

An energetic impulse was given, at once, by the first consul, to extensive undertakings on the public roads, internal navigation, bridges, and the commercial and military ports of France, within its enlarged boundaries.

Napoleon entered, himself, into the profoundest questions of art and skill which his vast projects involved, with those select few whom he had distinguished in the various public services. Sganzin was then brought to share in the marked confidence and benevolence which the Emperor constantly bestowed upon his confidential advisers.

A circumstance occurred, which, though trifling in itself, serves to exhibit the ardor with which the genius of Napoleon engaged in the planning of his great public projects. One evening, after dinner, at the camp of Boulogne, he sent for M. Sganzin, to ask him some questions relative to a scheme on hand; after detaining him several hours, Napoleon perceived that his interlocutor appeared fatigued, and he soon learned from him that he had been long fasting. He immediately rang the bell, ordered in a supper for M. Sganzin, and while the latter was recruiting his strength, he continued to discuss the subject with him and write, in some sort, under his dictation.

It was the Emperor's habit also to request his officers to send him the rough sketches, and first draughts of the memoirs and reports which he had asked them to prepare, both that he might the better judge of the capacity of his agents, and seize the first impressions of their minds, and thus form his opinion, from the aspects under which the subjects had at first been viewed.

It was not long before Sganzin was promoted to the highest grade in the corps of Roads and Bridges; a decree of the consul, of 30 messidor, year 11, (19th June, 1803,) appointed him "inspecteur general des Ponts et Chaussées," and a few months after he was decorated with the legion of Honour.

Sganzin immediately, but in vain, claimed of the Emperor, the same promotion for his colleagues, Cachin and Ferregeau.

From that time Sganzin was directed to accompany Napoleon in all his journeys along the coasts of the empire, and received from him the most important commissions, sometimes alone, and sometimes with the illustrious academician whom the deep sagacity of the King has just called to the peerage.

It was thus that M. Sganzin had to organize in 1804 and 5 all the works at Boulogne and other places on the channel, during the projected attack on England; and he was subsequently associated in all the great plans of the Emperor at the ports of Antwerp, Flushing, the Helder, Niewdiep and various other points in Belgium and Holland.

In a first journey to Italy, in 1805, with de Prony and Sanè, Sganzin prepared, in conjunction with them, the vast plans which the Emperor had conceived for the improvement of the forts of Genoa and Spezzia.

He had scarcely finished this mission when he had to repair to Belgium to preside over the enlargement of the great dock at Flushing, the execution of which was confided to M. Boistard, then chief engineer of maritime works, and M. Lamblardie, his son, engineers in ordinary. In less than a year, and at a moderate expense, this great hydraulic achievement gave passage to ships of the line, by the employment of an entirely new system which will probably find frequent applications in great commercial seaports, when it becomes necessary to adapt them to the dimensions of steam ships.

A second mission to Italy in 1806, in which M. Sganzin was connected with de Prony, was for the purpose of raising from its ruins the ancient port of Venice, which had been the cradle of modern commerce. Eventually towards the close of 1807 he accompanied the Emperor to Venice, and was charged with the exploration of various ports of the Adriatic, of Friuli, and of Illyria.

Scarcely had the French flag penetrated into Spain, in 1808, before the eagle eye of Napoleon was turned to the ports of his new conquest, and it was again de Prony and Sganzin that received orders to examine all the ports of the coast from Bayonne to St. Sebastian, and to collect materials needful for the arrangement of the projects which the Emperor had formed. The vicissitudes of our arms and other political engagements in the East and North of Europe prevented the execution of the views of Napoleon upon the Spanish ports.

These distant missions,—a participation in the discussions of the council of maritime works and in those of the general council of Roads and Bridges,—journeys in the suite of the Emperor, into Belgium and Holland, in 1809—11,—and special excursions to some ports of France, did not interrupt the course which M. Sganzin gave in the polytechnic school, and as early as 1807 he had orders to publish, hastily, his instructions in a substantial form. This work, under the modest title of a *summary* (Resumé) has been long the almost sole guide of the pupils of the polytechnic school, scattered throughout the various ranks of the public service, and having reached a fourth edition, it still remains to be justly in favour with the public.*

In 1812 the course of the polytechnic school was suppressed, from considerations of economy, and M. Sganzin obtained a pension of 3000 francs which was reduced in 1818 to 1900 francs. He took no part of this grant during the whole time he was in active service.

The malevolent jealousy which the confidence of Napoleon had excited against him, succeeded at length in diverting the favour of the Sovereign: the Emperor was induced to believe that Sganzin was in possession of a great landed estate, and that he was very rich, notwithstanding the evident falsehood of such absurd allegations.

At the restoration, Sganzin was found to be simply a member of the legionary corps. He was invested by the King solely, with the general inspection of all the naval depots except Cherbourg, he was nominated an officer of the legion of Honour, in 1814, and afterwards in 1819 on the proposition of M. Portal, then Minister of Marine, he was created Knight of the order of St. Michael.

*A translation of this work, from the 3rd French edition, was published in Boston, in 1826, and is used as a text book in many of our schools. Trans.

At this new period of his life, Sganzin, who had attained the age of 70, still retained his wonted vigour of mind and body. Frequent tours of examination among the ports,—a journey to England, relative to the suspension bridges purchased for the Island of Bourbon, in which he contracted an amiable alliance with the celebrated Brunel,—an investigation of the projects formed for the restoration and enlargement of the ports of old France, neglected during the latter years of the empire, did not prevent him from participating in the deliberation of the general council of roads and bridges, and of the joint committee of public works and light houses.

The death of Cachin in 1824 placed M. Sganzin, in the sole authority of the Marine depots, by reassigning to him the port and harbour of Cherbourg.

At the close of the same year he was appointed a member of the committee of consultation of naval depots, recently created, and shortly after he became its President by age and rank, which he held till 1831, when this commission was replaced by the existing council of which he continued to be a member.

The gradual failure of his memory and other faculties prevented him, in the latter years of his life, from taking an active part in the various services which had so long engaged his attention. Agreeably to his wishes the son of his former friend, now his own by adoption, was connected with him as adjutant inspector, and succeeded him in April 1835, when the King, by appointing M. Lamblardie inspector general of roads and bridges, made the most agreeable provision for the preservation of the titles and comforts of the family. The Cordon of the Legion of Honour, was the last reward conferred on M. Sganzin, on his retirement, at the age of 87, after 62 years of efficient service.

From the time of his retreat, to the 10th of January 1837, the day of his decease, Sganzin's memory, except at intervals, appeared to be almost obliterated. He died at Bougival, near Marly, surrounded by the pious attentions which had been devoted to him for nearly 30 years, leaving to his adopted family only the inheritance they had received from their own distinguished father, and the honorable memory of a life unremittingly devoted to his country and his duties.

Sganzin left two nephews of the same name, whom he had educated at his own expense, who, following his example, became attached to the public service, in which they both, at present, count long years of honorable activity, the one a marine engineer, and the other as an officer of artillery.

The public functionaries of every rank and department, with whom M. Sganzin held any relation during this long career of 62 years service, commencing in 1775, bear united testimony to the uprightness of his intentions, to his talents, and to the sagacity of his judgment, enlightened by long experience. The engineers who served under his orders, will never forget, that, under an apparently formal exterior, he cherished the warmest benevolence, the most earnest desire to assist them under all circumstances, to defend their interests, and to procure for them the rewards of which he deemed them to be worthy.

Annales des Ponts et Chaussées 1837.

A Summary view of the Progress of Architecture in Britain during the past Year; with some Notices relative to its state in Foreign Countries.

By J. C. Loudon, F. L. S., &c.

The year 1837 scarcely affords any marked feature of architectural

progress, such as the competition for, or completion of, any great national work; but it exhibits what is much more satisfactory, a general spirit of architectural improvement in the metropolis, throughout Great Britain, and, to some extent, even in foreign countries.

In London, there is scarcely a principal street that does not exhibit some new architectural feature; public institutions and companies, and even eminent commercial houses, being alike eager to attract attention by an improved architecture without, no less than by superior arrangements within. These kinds of improvement have been going on, more or less rapidly, since the peace of 1814; and the former appears to have received a considerable stimulus, a few years ago, from the general rage for ornamenting the fronts of gin shops and public houses. Most of these buildings, indeed, exhibit very inferior specimens of design; but, as they have advanced a step beyond what had gone before in the same kind of houses, they ought not to be despised; and however common it may be for architects to laugh at the splendour of gin temples, yet it cannot be denied, we think, that to them the architects and architecture of the metropolis are considerably indebted. Among the buildings of public companies may be included the club houses, bazaars, insurance offices, and banking houses; and, among these, we may point to the Oxford and Cambridge University Club-house in Pall Mall, the Pantheon Bazaar in Oxford street, and the Atlas Fire-office in Cheapside, as very handsome public ornaments. The Pantheon is deservedly admired for its interior arrangement and decoration, and the Fire-office for its exterior elevation. Among public institutions may be noticed the Surgeons' Hall in Lincoln's Inn Fields, and the City School in Wood street, Cheapside; and a number of other schools, together with various churches and chapels, might be enumerated, if the object were to do more than take a cursory glance at general features. The New Palace at Pimlico has this year been taken possession of by Her Majesty, and the New Houses of Parliament commenced.

Throughout the country, architectural improvement is general. There is hardly a large town in which some church or school has not been recently erected. New markets or town halls are completed in some places, and in progress in others; and public cemeteries and cemetery chapels are increasing every year. Perhaps the best markets completed during the past year, are that at Exeter, by Mr. Fowler, and that at New Castle, by Mr. Grainger. The town in England which is, perhaps, undergoing the greatest architectural improvement is, however, Newcastle, where Grey street promises to be, when completed, one of the handsomest streets in England.

On looking over our Provincial Notices, under the heads of Scotland and Ireland, evidence will be found that architecture is not stationary in these countries, though we cannot point to any particular feature in either which characterises the year 1837.

Among foreign countries, France appears to take the lead. Munich and Berlin may be considered as next in the order of architectural ameliorations; but Belgium, Russia, and even Greece, Italy, and Spain, might be cited in evidence of improvement. The state of architecture in the United States is noticed; by which it appears that banking houses, hotels, and theatres are erecting, with an increased regard to architectural effect.

If the progress of architecture in Britain is considerable, that of engineering may be considered as extraordinary. The railway between Birmingham and Liverpool has been opened in the course of the year, and the following railways are in progress:—the London and Birmingham railway, which is already opened as far as Tring, and which will probably be completed in 1839; the Southampton railway, which will probably be completed about the same time; the Great Western railway, the works of which are far advanced; and the Eastern Counties' railway; the Northern and Eastern railway; the Croydon, Greenwich, and Brighton railways; and the London Junction railway, which are all more or less in progress. The works in the Thames Tunnel, that very remarkable undertaking, which, now that the company has received the assistance of government, may be considered as national, are going steadily forward, though occasionally interrupted by irruptions of the river.

The architectural literature of the year includes the *Transactions of the Institute of British Architects*, and the *Transactions of the Institution of Civil Engineers*, both of which contain many valuable papers; several pamphlets relative to the new Houses of Parliament, which contain some interesting discussions; The Report from the Select Committee on Arts and their connexion with Manufactures, which indicates an increased attention to these subjects on the part of government; a translation, with notes, of *Vicat on Mortars and Cements*, a work which was much wanted; and a *Lecture on the Dry Rot*, by Dr. Dickson, which contains information respecting the Kyanising process, well deserving the attention of builders, who, in general, do not seem to understand the mode of its application. Among the articles in the present volume of this Magazine, the two which we consider the most valuable are those by Dr. Ure and Mr. Richie, on Warming and Ventilating. For critical remarks, those of Candidus are highly instructive; and there are many papers of a practical nature, by other writers, not less so.

Architectural Magazine.

Formation of a School of Design in Manchester.

A short time ago, a number of gentlemen of this town, sensible of the importance of a school of design in this great emporium of arts and manufactures, assembled and formed a provisional committee for the purpose of taking the steps necessary to originate such an institution. At first it was contemplated that it should be a branch of the recently founded school of design in the metropolis; but much disappointment was experienced on finding that there the mechanics were debarred from an equal share in the privileges and studies of the school, and it was ultimately determined that the Manchester School of Design should be a wholly separate and independent institution. At a general meeting of gentlemen favourable to the establishment of a school of design in Manchester, convened by the provisional committee, an animated debate took place; James Heywood, Esq., chairman of the provisional committee, presided, and opened the proceedings. In the course of an excellent speech, he stated that from time to time many efforts had been made by individuals to improve the fine arts in Manchester by their own exertions, and he thought great praise was due to those persons; but very little had hitherto been done by any public body, for the improvement of the arts of design. The Mechanics' Institution had come forward

more directly than any other body, having formed classes in several departments of design; as mechanical, architectural, flower, figure, and landscape drawing; and in 1835, the class for mechanical and architectural drawing had an average attendance of 33 pupils; and that for landscape, flower, and figures, of 64 pupils. He hoped these classes would continue to prosper; but what was now wished to be effected was, the formation of a society having for its sole and peculiar object to improve the arts of design, an object sufficient to occupy the whole time and attention of a society with reference to the improvement of those manufactures in which design is required; and also in the education of persons to direct the mechanical powers of this great community. Elsewhere such objects were thought of great importance. Lyons, which rivalled Manchester in many respects, and exceeded it in the taste of its inhabitants in design, had regular schools of design, in which particular attention was paid to the departments of flowers and ornamental drawing. When at Lyons, some years ago, he had obtained an account of the subjects proposed for prizes in an exhibition, where prizes to the amount of £20 or £30 were given for drawings and paintings. Those subjects were:—coloured drawing, including ornaments, figures, and flowers, in the same composition; groups of coloured flowers; selections of plants, drawn after nature, slightly shaded, of the natural size; the plants separated, so as to exhibit the principal details of flower and foliage under different points of view, not as botany would require them to be exhibited, but as they would be considered most beautiful in art.

Mr. T. W. Winstanley read the following report of the provisional committee:—

"The diffusion of knowledge, in whatever department of science it takes place, is a subject of great interest to every lover of public improvement; and the formation of a school of design, in the town of Manchester, must tend to its commercial, as well as classical, prosperity, and must also prove beneficial to the inhabitants of the surrounding towns.

"Manchester, as the great emporium of human industry and production, creates within herself a considerable demand for the decorative and ornamental departments of design, in the operations of calico printing, fancy weaving, and embroidering. Individuals employed in these branches of art require an institution for the improvement of taste, and for the encouragement of harmonious conceptions in beauty and form. Such an institution is equally requisite for students in civil engineering, to whom precision of design, and the skilful use of instruments, in surveying, planning, &c., are essentially necessary in their professional pursuits.

"It has been well remarked, by the Baron Charles Dupin, in his advice to manufacturers, and to the foremen of workshops, that the only efficient means to encounter competition is, to manufacture goods really better than all our competitors.

"Superiority in manufacture depends, in a great measure, on the fortunate exercise of taste, economy, industry, and invention. The establishment of a school of design, in Manchester, is recommended, in order to enhance the value of the manufactures in this district, to improve the taste of the rising generation; to infuse into the public mind a desire for symmetry of form, and elegance of design; and to educate, for the public service, a highly intelligent class of artists and civil engineers.

"Impressed with these views of affording encouragement to the cultivation of the arts of design in Manchester, the present meeting has been called, in the confident expectation, that a society will now be formed for

that object, and that the patronage of this influential and wealthy community will not be wanting to the successful execution of a plan which promises so much advantage, both to individuals and to the public."—*Manchester Guardian, Feb.* 21, 1838. Ibid.

The Thames Tunnel.

The engineers of this great undertaking have again succeeded in recovering possession of the works at the Tunnel. The usual means were taken to stop up the aperture in the bed of the river which led to the late irruption. The shore engine was set to work on Friday, and on Saturday afternoon the water had been pumped out of the shaft to the extent of six feet below the crown of the arches of the Tunnel. It is confidently expected that the works will be resumed again in a few days.

April 11, 1837.—Mr. Brunel gave an account of the Thames Tunnel. Having described the nature and difficulties of the undertaking, and the previous attempts which had been made by others to effect a similar work he explained, by reference to sections, the nature of the strata below the river. He had adopted the rectangular form of the present excavation, because the work would set better than if of any other form, and had a better sustaining surface. The necessity of supporting the ground, and of having a sufficient shelter, had led to the adoption of the shield, respecting which so much had been said. The construction of this would be understood by conceiving twelve books set side by side on their ends. These would represent the parallel frames which, standing side by side, but not in immediate contact, fill up the excavation. Each frame is divided into three boxes or cells, one above the other; the adjustment of the floors of which, and other details, were minutely described by Mr. Brunel.

Each frame is furnished with two large slings, by which it may derive support from, or assist in supporting, its neighbours; it has also two legs, and is advanced as it were by short steps, having for this purpose an articulation which may be compared to that of the human body. The frame rests on one leg, and then one side is hitched a little forward; then resting on the other leg, the other side is hitched a little, and so on. Hence the shield may be called an ambulating coffer-dam, going horizontally.

The brick-work is built in complete rings, and the advantages of this system of building had been fully proved by the fact of two dreadful irruptions having produced no disruption. Such was the violence of the irruption, that the brick-work had in one part been suddenly reduced in thickness by one-half, and in one place there was a hole as if pierced by a cannon ball. At a few feet beneath them is a bed of quicksand fifty feet deep, and above them strata of most doubtful consistency, some of which goes to pieces immediately on being disturbed. Still however, their progress is certain, and they only require patience to allow of the ground above them acquiring sufficient density. He found gravel with a mixture of chalk or clay extremely impervious to water; in some cases he contrived to let out the water from the sand above them, and thus obtained ground of sufficient density. In their pro-

gress they were considerably annoyed by land springs, which produced cutaneous irruptions, and destroyed the finger nails of the workmen.

April 18, 1837.—Mr. Brunel gave further explanations respecting the Tunnel. He explained the way in which the ground above them had suddenly sunk down, owing to the run of a lower stratum of sand. This running sand, which was a very great annoyance, consisted of *five* parts water and *one* sand. Bags of clay and gravel are not best where there are many stones; for the interstices do not become properly filled up; but, in these cases, the coarsest river-sand is best; the water runs through at first, but soon stops; gravel and clay mixed are nearly impervious to water, but not so impervious as gravel and pounded chalk.

Mr. Gibb stated that he had found bags filled with clay and tow-waste exceedingly impervious to water. Being called upon to rebuild a sluice in a place where piling, owing to the stony nature of the ground, was impossible, he had formed a coffer-dam by laying down bags full of clay and tow-waste, in tiers of four, formed on the top of each other to the surface of the water.

The ventilation of the Tunnel is effected by a pipe of fifteen inches square, passing out under the fire-place of the steam engine boiler.

Repert. of Pat. Inven.

Transactions of the Institution of Civil Engineers.

"*Result of experiments made with a view to determine the best figure and position for wooden bearers, so as to combine lightness and strength; by* James Horne, F.R.S.; A. Inst. C.E."

The results of several experiments on wooden bearers of different sections are tabulated; together with the dimensions and weights of the pieces, and the nature of the fracture. The conclusion at which Mr. Horne arrives is, that a triangular prism placed with its base upwards is the strongest figure and position, that with an edge uppermost, the weakest, for a given quantity of material.

Vibrations of the soil from the passing of Locomotives, &c.

The subject of the vibrations produced in the soil by the passage of locomotives and coaches was discussed and several instances were mentioned, in which the vibration of the soil was sensible at the distance of a mile and a half during an observation by reflexion. It was stated that the experiments recently made for determining the effect which the passage of the locomotives at a small distance might have on the observations at the Royal Observatory, had not been conclusive; but that as no sensible effect could be produced on any observations but those by reflexion, no apprehension of inconvenience was entertained.

It was also stated that a number of persons running down the hill in Greenwich-park produces a slight tremor, which is quite sensible during an observation by reflexion, and that the shutting of the outer gate of the Observatory throws an object completely out of the field of the telescope.

The comparative merits of the single pumping and the crank engine for the purpose of raising water, were discussed.

Mr. Simpson stated that it was a generally received opinion that a single pumping engine would do one-third more duty than a crank engine; but that having recently had a crank engine altered by Messrs. Mudslays and Field, and fitted with expansion valves, it did the most duty.

The two engines were worked from the same boiler. The duty of the crank engine was about thirty-two millions; it works to a fixed lift, which is in some respects advantageous. The duty of the Cornish engines is reported at ninety-five millions; and an engine near London, in which the Cornish valves and system of clothing had been adopted, was doing a duty exceeding fifty millions.

With respect to the Cornish engines, it was stated that their superior duty was due to the system of clothing; that although many persons had examined their duty, the calculations appear to be made from the contents of the working barrel; that the Cornish bushel is 90 or 94 lbs. of very superior coal; the London bushel being only 80 or 84 lbs.; that, notwithstanding the great duty done by the pumping engines, the engines in Cornwall are doing less duty than the crank engines in London.

"*Notice concerning the Thames Tunnel;* by Richard Beamish, M. Inst. C. E."

Several attempts have been made in former years to effect a communication betwixt the opposite shores of the Thames by means of a tunnel, all of which, however, failed. In 1798, Dodd proposed a tunnel at Gravesend; and in 1804, Chapman proposed one at Rotherhithe; and in 1807, Vazie commenced the construction of a shaft, eleven feet diameter, at a distance of 315 feet from the river. With Vazie was associated Trevethick, a man of great practical knowledge as a miner; and by indefatigable labour, a drift-way, five feet in height, two feet six inches in breadth at the top, and three feet at the bottom, was carried 1046 feet under the river. In the spring of 1808, having first ascended from under a rocky stratum, though with a depth of at least twenty-five feet betwixt them and the bed of the river, the Thames broke in upon them, and not a single brick having been laid, the work was irretrievably lost.

In 1823, the subject of a tunnel was again agitated, and a company was formed to carry into execution the plans of Mr. Brunel. The first proceeding was to sink a shaft. Twenty-four piles, with a shoulder on each, were first driven all round the circle intended for the shaft. One side of a wooden platform, or curb, was then laid on this shoulder, whilst the other side rested on an iron curb, having an edge below to which it was attached. Through this curb, ascended forty-eight wrought iron bolts, two inches in diameter, to the height of forty feet, the height to which it was proposed to raise the shaft. The regular building of the tower on the curb, with bricks laid in cement, was proceeded with, and yet farther bound together by twenty-six circular hoops of timber, half an inch thick, as the brick work was brought up. At the top of the tower was placed another curb, and the long iron bolts passing through it, having their ends formed into screws, the whole was screwed solidly into one mass, and completed in three weeks. In a week after it was finished, sixteen of the piles having been driven, two by two, opposite each other, the whole structure was sunk half an inch, carrying down with it the remaining eight piles, on which it was brought to

a rest uniformly and horizontally, thus permitting the sixteen piles to be abstracted by opening the ground at the back. The whole weight supported by these eight piles, was about 910 tons, (the weight of the shaft.) Having been left for three weeks to dry, and gravel having been heaped under the curb, the remaining eight piles were removed, two by two, till the mass rested on a bed of gravel. The machinery, viz: the thirty-horse high-pressure steam engine, with gear for raising the excavated soil, was now fixed on the top. The miners were placed inside, and by excavating from around the bottom, the whole descended by its own gravity.

Mr. Beamish then describes the peculiar difficulties which were experienced previous to the first irruption.

The chasm in the bed of the river, formed by the irruption of 1827, was stopped by bags filled with clay, with hazel rods passed through them; and the interstices filled by gravel. The irruption of 1828 was met by similar means, but the funds of the company not being then sufficient for proceeding with the work, the shield was blocked up with bricks and cement, and a wall four feet in thickness was built within the tunnel.

For seven years the work was abandoned, till, in 1835, a Treasury loan was granted, subject to the condition that the most dangerous part of the tunnel should be executed first. On resuming the works, the first object was to provide a drain for the water from the shield, for which purpose two reservoirs were formed under the middle pier, from which drifts were formed to the bottom of the great excavation shield. The water was abstracted from the shield at the lowest point, and the pipes of two pumps worked by the steam engine, being brought into the reservoir, all the difficulty of the drainage was overcome.

The removal of the old, and the introduction of the new, shield, was a work of no ordinary difficulty. The bricks and cement had, by the strong oxide of iron which the water contains, been converted into a mass harder than most rocks; and not less than 1646 feet of surface, 342 of which constituted the ceiling, had to be supported on the removal of the brick work previous to the introduction of the new shield. The means, however, adopted by Mr. Brunel, and which were described in the paper, were perfectly successful. Lond. Journ. Arts & Sci.

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*On Pumps used in Mines.** By John Taylor, Esq., F. R. S., &c.

The extent to which pumps are used in England for the drainage of mines, which would be inaccessible without them, renders all information upon the subject important, and every thing that may conduce to their perfection worthy of regard; as the metals are exhausted from such places as are capable of being laid dry by levels, recourse must more and more be had to means for raising the water, which presents so formidable an obstacle to works which have not only to surmount this difficulty, but many others, which try the skill and patience of the miner.

The vast produce of copper in Cornwall is chiefly raised from depths far below the level of the sea; and those depths are securely and uninterruptedly drained by the application of the enormous power of many steam engines lifting great columns of water in the way I have pointed out.

At the Consolidation and United Mines, the aggregate power of the steam

*The "Mining Review and Journal of Geology," by Henry English, No. VIII, from which this extract is taken, contains three large plates, descriptive of the structure of pumps used in draining mines. G.

engines for pumping is nearly that of 2,000 horses, constantly working; there are, altogether, seven, of which four are of the largest class ever erected, having cylinders of ninety inches in diameter, with a stroke of the pistons of ten feet, the first engine ever constructed of this dimension being erected for this mine, by Mr. Woolf. The pumps are generally of sixteen inches diameter, and the whole length of the column lifted is nearly 800 fathoms, divided into lifts of about thirty fathoms each; the quantity of water discharged into the adit level is, when the engines work at the rate of eight strokes per minute, more than 38,000lbs., or above 100 barrels delivered in that time.

But the largest quantity of water lifted by pumps from mines in this country, is at the Mould Mines, in Flintshire, where the power applied is derived both from steam engines and overshot water wheels; of the former, there are seven, with cylinders from thirty-six to sixty-six inches diameter; of the latter, four of forty-four feet diameter each. The pumps are of extraordinary dimensions, being from twenty-two inch bore to ten inch, but the principal part of eighteen inch, reckoning always the diameter of the working barrels, or the plunger poles. Fifteen lifts discharge into the different adits, and often deliver more than 80,000lbs. of water per minute, from a depth averaging about fifty fathoms.

Mines circumstanced as these and many others are, must depend upon well arranged machinery to permit their being worked; and we owe to steam engines, and the improvements in them, which have rendered their use economical, the access to many of those stores of the metals in this country, which not many years ago were sealed up and could not be approached. Some progress has been made in applying the same means to drain the deep mines of some parts of the New World, where heretofore animal power alone was employed in the manner which could only be effective at a great expense, or where the volume of water to be removed was inconsiderable, compared with that which is raised by pumps. An increasing interest will attend the subject of this communication, as it is more extensively called into use, and as greater depths are attained requiring the greatest perfection in design and execution, and this will be my apology for this slight attempt to describe the present state of this important branch of mining apparatus.

Mining Rev.

The Railway System.

The present period forms an era of much importance in the progress of the railway system, and more so, perhaps, in reality than in appearance, as we shall presently have occasion to show. It is often difficult indeed correctly to appreciate those important changes which are constantly altering the aspect of society, while they are yet slowly passing before our eyes, their real magnitude and effects obscured by prejudice or other temporary causes.

The excitement of 1835 has, doubtless, had a vast and permanent influence on the railway system, both beneficial and prejudicial; its effects were beneficial in many respects, as it first brought this mode of communication before the public in that prominent and conspicuous point of view which its extraordinary merits and utility demanded, thus attracting that vast amount of capital to this new mode of investment, without which no effectual progress could be made. Extensive undertakings were projected and put in execution, which, at any other time, would long have remained dormant and neglected, while the talent of numerous individuals received a power-

ful impulse towards a costly, but as yet almost infant art, in which there was ample scope for its display. On the other hand, however, evils of no small magnitude were incurred—speculation, once aroused, was not nice in its choice of objects, and the visionary scheme, which existed merely on paper, or in the minds of fraudulent or misguided parties, met with too ready and indiscriminate a reception from the public generally, while premiums, often extravagantly high, were lavished without thought or judgment upon every concern which was ushered into notice. Apprehension and disgust soon followed—individuals lost their money, and railways lost their character; nor need we call to mind the long season of difficulty and depression which thence ensued.

Had the railway system rested on no good foundation—had it not been characterised by an inherent soundness, and ranked as one of the greatest and most beneficial inventions of the present wonder-working age, it would long have lain dormant after so terrible a reaction, nor should we now, or on several late occasions, have been called upon to notice its returning hold upon the public mind. The case is, however, different—railways have struggled through the temporary difficulties by which they were surrounded, and are now looked upon with scarcely less interest than at the period to which we have just referred, although experience has fortunately sobered down extravagant expectation, and, to a great extent, checked the farce of exorbitant premiums.

If we examine the actual state of railways, or of railway works at the present time, the contrast with any former period must be most gratifying, as the reports furnished weekly in our columns will, in most cases, tend to show. Stupendous works, which, a year or two ago, were hardly traced on the ground, are now either completed or verging towards completion. Enormous sums, the practicability of raising which was then almost a matter of doubt, have been forthcoming, notwithstanding all the difficulties of the times; and what is even more gratifying, the profitable results of railway investment have received the most satisfactory of all confirmations—that of increased experience. Mining Journal.

Experimental Brick Beam.

Messrs. Francis and Sons, the Roman cement manufacturers, at Nine Elms, some time ago erected what is termed a "Brick beam." This beam was composed of 19 courses of gray bricks, cemented together with the best Roman cement instead of mortar, and having in some of the courses hoop iron placed horizontally. The length of this beam was about 24 or 25 feet, the ends resting on upright gables or pedestals. The width of the beam was two bricks and a half, placed lengthwise. The purpose was to show the efficacy of the Roman cement by its adhesion to the hoop iron as well as to brick, and its consequent adaptation, at a comparatively small expense, to many purposes where an arch could not be so conveniently used, such as railroads, &c. For some time past a weight of iron, amounting to nearly 11 tons, has been suspended by chains over the beam, and it has stood firm and unmoved. Messrs. Francis resolved, on Wednesday, to test to the utmost the strength of their contrivance, and commenced at half-past twelve o'clock gradually to increase the weight attached to the chains. At half past two o'clock the weight suspended across the beam was upwards of 22 tons, and at that time the pedestals began to diverge a little outwards, and in a moment afterwards the beam broke across at the place where it was

traversed by the chains. The rent, or break, was almost as clean as if cut with a knife; there was no crumbling of the cement, nor did the bricks separate from their interstices, the whole fracture was as if a piece of solid rock had been suddenly divided by some irresistible power. As far as the goodness and efficacy of the cement were concerned, the experiment was perfectly satisfactory. There can be no question that a beam of this sort may be made available for many purposes; whether or not the rumbling of carriages over bridges built on this principle, or on a viaduct, would, by the vibration, cause any alteration in its stability, remains, perhaps, to be proved. From what was seen yesterday, enough was proved to evince the very superior tenacity of the cement, and to show that an important improvement has been introduced at a very low rate of additional expense.—*Times.*

Lond. Mech Mag.

Mechanics' Register.

European Lead Mines.

The vast supply obtained from the deposites of lead ore existing in the range of mountains called the "Sierra de Gador," in the province of Grenada, has had, for many years past, a very material influence upon the lead mines of England, and was the cause of that severe depression which, for a time, almost threatened to annihilate this branch of mining industry. The produce of lead from the mines of Great Britain amounts, on an average, to about 45,000, or from that to 46,000 tons annually, being a production very far exceeding that of any other country—and to which, indeed, that of Spain alone bears any proportion. The above produce of lead is greatly beyond the amount required for home consumption—thus leading to a very large export of this metal, amounting, previous to the effectual working of the Spanish Lead Mines, to between 16,000 and 17,000 tons per annum, or rather more than one-third of the whole produce. The Spanish Mines appear to have been called into activity by the excessively high price of the metal which prevailed in the year 1825; and their produce, which was not before very considerable, soon amounted to about 20,000 tons per annum—the Government having been prevailed upon to relax from its former principle of not allowing the exportation of mineral produce. Under this new regulation, a large portion of this produce soon found its way into those markets which had previously been supplied by England, and thus lessened the usual demand to such an extent as to produce a frightful depreciation in the price of the metal. This state of things continued for several years: the produce of the Spanish Mines soon increased to about 27,000 tons per annum, which may be considèred as their maximum; and although less productive latterly, the large quantity exported has still had a very injurious effect on the price of the metal, and more especially, for some time past, when, from the general stagnation of commercial affairs, the demand has been small, and the price rapidly declining.

These restrictions rendered it imperative for the mines to be entirely closed for the space of one year, no other operations being permitted than those necessary to realise the produce now on the surface. The present produce of the Spanish Mines is estimated as exceeding 22,000 tons per annum; but for the next twelvemonth will not probably amount to more than 3,000 tons—a reduction so considerable that it cannot fail to be generally felt, and consequently to have some effect in raising the price of the metal.

Mining Journal.

Hydro-Pneumatic Telegraph.

We have seen a model of a telegraph invented by Mr. Rowley, Surgeon, Royal Navy, of Grosvenor-street, Charlton-on-Medlock, which possesses the merit of novelty, at least, if not, efficiency. It consists of a number of lead pipes, of from a quarter to half an inch bore, each connected at one end with an air receiver, inverted in water like a gasometer, and each having a separate stop-cock; the other end of each pipe being immersed in an eight-ounce white glass bottle, three-fourths full of water. The pressure on the air in the receiver, of course, propels a stream of air along any pipe of which the tap is so turned as to admit air; and the effect of this is an instantaneous bubbling of the air at the extremity of the pipe, as it escapes through the water in the bottle. The pipes in the model are about ten feet in length; but the inventor has tried an experiment with a length of the same piping, extending (in coil) to the length of four hundred feet; and simply blowing into one end of the pipe, the bubbling in the water was produced at the other almost instantaneously. It is obvious, that, the pipes always containing air, any quantity suddenly forced in at one end must produce a concussion which is transmitted with great velocity through the whole length, and the same quantity of air must be expelled at one end as is thrown in at the other. The details of the adaptation of this principle to telegraphic purposes are perhaps scarcely matured in the consideration of the inventor; but the following will be found to be the principal points. Six pipes so prepared and marked at each end in this way:—

*	A	B	C	D	E
	1	2	3	4	5

The one marked with an asterisk or star, it is proposed to use as the preparatory signal, to call attention at the other terminus, and also a stop between each word or signal. The permutations and combinations of the five letters alone would form a tolerably copious stock of signals; but these might be extended immensely by a variety of well-known contrivances. With respect to the cost of a telegraph of this kind, it is clear that the pipes would form the most considerable item. Lead piping of sufficient bore could be supplied, we believe, at something more than £20 a ton: and of this piping a ton weight would make a mile in length. In application, for instance, to the Liverpool and Manchester Railway, each pipe would cost £600, or £3,600 for the six pipes, and the whole cost of such a telegraph for that distance would not be more than £10,000. The inventor has little doubt that a communication could be made to Liverpool, and an answer received in Manchester, in a few minutes, and quite as easily by night as day, if that were necessary. This telegraph would not need to be attended by any scientific person; any one of ordinary intelligence would be capable of managing it, and transmitting any desired communication. At present the model is only constructed to work in one direction; but it is very obvious, that by having double terminations to the pipes, they may be made to convey intelligence in either direction. We must confess we are rather sceptical as to the accurate working of a telegraph on this construction between any two distant points, as for instance, between Manchester and Liverpool. Perhaps if the pipes were quite perfect in their whole length—free not only from fissures, but from irregularities at the joints—the impulse given at one end might be communicated with tolerable certainty and exactness at the other; but we imagine it would be somewhat difficult to lay thirty miles of pipe that would be free from such imperfections, and they would, in all probability, very seriously affect the result. We con-

ceive that along a very good pipe the impulse would proceed in much less time than along a bad one, so that the signal made at the first, might arrive before the second, and the figures 91, for instance, might be turned into 19. It is a point, however, on which experiment alone could give a satisfactory decision.—[*Manchester Guardian.*

Lond. Mech. Magazine.

I am inclined to think that the easy compressibility of air, might prevent the impulses from reaching so great a distance as 25 or 50 miles.

G.

The Davy Lamp.

The following directions are given to miners in the use of their great protector, the lamp invented by Sir Humphrey Davy:—Whenever your gauze is coming to a *cherry-red heat*, be careful, and do not remain long, unless your business be *exceedingly* pressing; and, even then, your lamp must be changed, and that very often, and carefully. Caution is exceedingly requisite in moving it out to get cooled and exchanged. Have no oil on the gauze, nor have any defect in it. The above is an extreme case, in which the *greatest* care is needful. When you are traveling you should not allow the gauze to attain this heat; but should, on the approach to it, return into other air. You should often carefully examine your lamp, and then you will have timely notice of the approach of such dangerous circumstances. You will perceive first a high coloured spire on the flame; and that will be succeeded by a long one, even reaching to the top of the lamp, and then this will expand, or become larger, until your lamp soon becomes insufferably hot, and then speedily comes the cherry-red heat; then there is *great* danger. Observe, through all these transitions, even from the first appearance of the blue-coloured spire to the last, there is danger in exposing the naked flame. As soon as you see the long spiry pillar, it would be well often carefully to change the lamp. In a record of the various accidents in coal pits, on the Wear and Tyne, near Newcastle, since the year 1658 to 1838, amounting to 135 in number, only *one* out of 135 can be traced to the Davy, and that was by a boy letting it fall in changing it.—The gauze was damaged and then exploded the mine. Mining Review.

Oats changed to Rye.

In an article in Loudon's Magazine of Natural History, for November, 1837, various instances are given in which Oats that had been clipped for a few times in the warm season, so as to prevent them from forming stalks, and to enable them to live through the winter, had, during the second spring and summer, yielded a thin crop of Rye. The statement is not given by the author of the paper, or published by the editor, as a proof that Oats are changed into Rye, but as remarkable cases of a peculiar succession of vegetable species, under circumstances which render it very difficult to assign an adequate reason for the phenomenon. In one of the cases, the ground on which the oats were sown had been in grass for the last 15 or 20 years, and then planted with potatoes for 2 years, and then sown with oats and lucerne, which were used as sheep pasture so as to prevent the oats from stalking. The Oats were mostly killed by the severity of the cold in the spring, but when the lucerne was fit for pasture it was found intermixed

with a great many healthy rye plants just in flower. Perhaps some of our readers will repeat the experiments. The cases alluded to occurred on the continent of Europe. G.

Mr. Turner's Theorem.

Sir W. Hamilton at the late meeting of the British Association, made an exposition of Mr. Turner's theorem respecting the series of odd numbers, and the cubes and other powers of the natural numbers. Sir William stated, that if you take the series of odd numbers and divide them into groups, as below, of one, two, three, &c. terms, consecutively, the sums of these groups furnish the cubes of the natural numbers, as follows:

1	3 5	7 9 11	13 15 17 19
Sum$=1$	Sum$=8=2^3$	Sum$=27=3^3$	Sum$=64=4^3$.

And a theorem of a general kind could thus be stated: any power, n^m of any number $n=$ sum of n consecutive odd numbers, the extremes being the sum and the difference of the next less power n^{m-1}, and the next less number $n-1$. For example, the 5th power of 3 is the sum of the three consecutive odd numbers, of which, the extremes are the next less power, namely, the fourth power of 3 or 81, and the next less number or 2, these extreme odd numbers being 79 and 83; the sum of all is $79+81+83=243=3^5$.

Professor Stevelly stated, that there was another curious property of the natural numbers, and their cubes, which he was not aware was generally known: it was this, that if you take a set of weights denominated by any number of the natural series of numbers and of their cubes, you can with these weights, by occasionally using some in one scale and some in the other, weigh up to the weight expressed by the sum of all used; thus:

1	2	3	4	5	&c.	natural numbers.
1	8	27	64	125	&c.	cubes.

Taking the weights denominated by 1, 2, 3; 1, 8, and 27, and you can with these six weigh any weight up to the sum of all, which is 42.

Lond. Mech. Magazine.

French Vineyard.

At the conclusion of an article of great learning and research, relative to the insects known to the Ancients and Moderns, by which the vine is infested, by Baron Walcknaer, (Scientific Memoirs, Part II,) the author concludes by the following statements: G.

In France, at the present day, 800,000 *hectares* [1,976,914 acres] of land are planted with the vine, the fruit of which, converted into wine, yields an annual produce of 760,000,000 francs, [£30,158,730 sterling.] The consideration, therefore, of the insects destructive of a plant which is the source of so much wealth, does not appear superfluous; and to lessen my regret at having so long occupied the time devoted by the Academy to researches of more importance, I would at least persuade myself that these minute inquiries are not devoid either of interest or utility.

Scientific Memoirs.

Belgian Railroads.

The line by which the Belgians propose to connect their western boun-

dary looking on the sea, with their eastern, bordering on Germany, is already so far completed, as to be opened from Termonde to Ghent. The ceremony took place on the 29th September: five locomotives drew a hundred carriages; music, fireworks, illuminations, and a banquet to king Leopold augmented the pleasures of the day. When the line is completed to Ostend, and a fast going packet placed on that station, the journey from London to Brussels may be effected in sixteen hours. Just double the time, or thirty two hours will be required for the passage from London to Paris, by a new route proposed by a French steam packet company, which intends to convey its passengers from London to Havre by a steamer, from Havre to St. Germain by the Seine, by a small boat, and from St. Germain to Paris by the new railway.

Lond. Mech. Mag.

The Soil of France.

The soil of France is estimated to contain nearly 52,030,000 of hectares, which are distributed as follows:—

Arable	22,818,000
Woodland	6,522,000
Pasture	3,525,000
Meadow	3,488,000
Waste lands	3,841,000
Vineyards	1,977,000
Lands in special cultivation	780,000
Market gardens	528,000
Plantations of chesnut trees	406,000
Lakes	213,000
Sites of chateaux, country seats, out buildings	213,000
Marshes	186,000
Hop grounds	60,000
Ozier beds	53,000
Olive grounds	43,000
Parks and nurseries	39,000
Mines and quarries	21,000
Bogs and turf grounds	7,000
Mountains, roads, and rivers	6,555,000
Canals	9,000
Total	51,291,000

Farmers' Magazine.

Releasing Stoppers from Bottles.

Sir, as I have no doubt others of your readers, as well as myself, have frequently been inconvenienced by the stoppers of glass bottles becoming fixed, perhaps the following method of extracting them may prove useful to them. It was communicated to me by Mr. H. H. Clark, of Sheffield, with whom it originated, and has, I believe, never been made public. Having wiped the neck of the bottle perfectly dry, and seen that the little groove or channel between the stopper and the neck is quite clean, pour into the groove a few drops of *spirit of wine*, and having set it on fire, let it burn out, and then immediately give the stopper a few gentle taps with a light

wooden instrument, as the handle of a small spatula or chisel, and try to turn the stopper in an upward direction from *right to left*. I have, in most cases, found this effectual; but if it is not so the first time, it must be repeated.—*J. Fordred.* Lond. Mec. Mag.

Iron.

In little more than sixty years, the manufacture of this article in Britain has increased from about 25,000 to about one million of tons per annum, and in case the cost of production be reduced one half, it is impossible to estimate the future rate of increase; and surely the reduction in the consumption of coal from 7½ tons for one ton of iron, to less than 1½ tons, warrants the anticipation that it will be great. As, however, some of these modern improvements seem to open the way for the manufacture of iron in America, it behooves our legislature to allow the Americans to find a market at fair terms for the produce of their soil in this country, and then many generations may pass away before they can interfere with us in the iron manufacture. If railway once be extended through the west of Cumberland, the excellency, the abundance, and the proximity of the materials for the manufacture of iron, can hardly fail to plant some important branch of the iron manufacture on our coast.—*Whitehaven Herald.* Mining Journal.

Singular Circumstance.

We have often read of the imprisonment of Toads in rocks, and trees, but never heard of any one of these animals revealing its own hiding place in the way here mentioned. G.

During the Christmas, as Mr. Lukey, of Carminow, near Helston, sat amusing himself by the fire, one evening, his ears were suddenly assailed by cries resembling those of an infant, which apparently proceeded from the chimney, where lay a huge log of wood on fire, as it had been for three successive days, according to the universal custom of country folks at this season. The cries continued to increase, and on examining the log of wood he discovered a small hole incapable of admitting his finger. He split the wood, and, to his great astonishment, found a large toad entombed in the centre.—*West Briton.* Ibid.

Coals.

In the year 1780, the demand for coals amounted to 2½ millions of tons per year; in the year 1838 to 18 millions. The increase of population (according to Bowring) has been during that period 90 per cent; the increase in the demand for coals 730 per cent, and it is calculated that there is no fear of a falling off in the supply for 2000 years.—*Raumer's England.* Ibid.

Comparative Anatomy.

A beautiful instance of the perfection of comparative anatomy, as applied to Ichthyology, was given by Sir P. Egerton to the Geological Section at Liverpool, on Friday the 14th. A scale found by him in one of the Yorkshire formations was sent to M. Agassiz, with a request that he would give his opinion as to the order in which the animal should be placed, and any detailed account of the probable shape and size of the fish he may think proper. This was done, and the whole organization of the fish regularly given. Sir Philip subsequently found a perfect specimen of the animal, which tallied exactly, *i. e.* as far as a fossil

would allow, with M. Agassiz's description. The announcement of this fact was received with great applause. Ibid.

Birmingham Railway.

This company has no less than 3000 men employed on the extension only from Camden Town to Euston-square, that is about one mile and a quarter. The daily wages of these men amounts to £600, or at the rate of £180,000 per annum. We think this looks like earnest and business. The works are executed, we are informed, for we have not seen them, in a very masterly and substantial manner.—*Railway Magazine.*

Ibid.

To preserve Wall Nails from Rusting.

I beg to communicate a little valuable information to those who use many nails for fastening wall trees. I use cast nails about one inch and a quarter long, and heat them pretty hot, in the fire shovel, over the fire, but not red, and then drop them into a glazed flower-pot saucer, half filled with train oil. They absorb a great deal of oil, and thus prepared never become rusty, and will last many years. The effluvia of the oil also, for a long time, I fancy, keeps insects from the trees.—*Magazine of Domestic Economy.* Farmer's Magazine.

Hydrogen Gas.

A scientific chemist, of great celebrity in France, has lately visited this country, for the purpose of taking out a patent for an economical process, by which he obtains from the decomposition of water, hydrogen gas, for the purpose of lighting houses and streets. His process has for some time been in very successful operation in France, but the method has been kept secret. He has now, however, undertaken to light the Royal Printing Office in Paris, with gas procured in the manner abovementioned.—*Birmingham Gazette.* Mining Journal.

Machinery vs. *Steam.*

A practical experiment was made on Saturday, March 24, on the Railway, of a newly-invented machine, intended as a substitute for a locomotive steam-engine on railways, particularly on short or branch roads, where the expense of a locomotive steamer would be too costly for the traffic. The action is produced by a horse walking at an ordinary pace on a jointed platform, attached to the vehicle by a series of concealed machinery, which is so contrived that his weight and muscular strength are brought to act together, and to communicate a multiplying force to the larger or outside wheels of the machine, which are capable of being increased or diminished at the will of the conductor, so as to regulate the required speed. The trial was perfectly successful, notwithstanding the disadvantages of an untrained horse and new machinery. On the first application, the horse moved at a pace of four miles an hour, and subsequently conveyed the machine, which, with thirteen persons riding in it, weighed altogether four tons, at the rate of sixteen miles an hour. Lond. Journ. Arts & Sci.

LUNAR OCCULTATIONS FOR PHILADELPHIA, OCTOBER 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
9	10	19	N. App. ☽ & 47 Geminourn	6 ☽ N.0.'3		
10	17	0	Im λ Cancri	,6,	11	320
10	17	39	Em.		317	276
26	10	55	Im. φ Capricorni	6	110	152
26	11	53	Em.		311	359
30	10	16	Im. (189) Piscium	6	118	123
30	11	26	Em.		321	345

Meteorological Observations for April, 1838.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	41	39	29.60	29.60	E.W.	Moderate.		Cloudy—do.
	2	32	49	65	55	W.	Brisk.		Clear—do.
	3	34	42	55	55	W.	Blustering		Lightly cloudy—do. do.
☾	4	33	59	63	65	W.	Calm.		Clear—flying clouds.
	5	37	59	85	95	W.	Moderate.		Clear—do.
	6	38	68	72	85	W.	Brisk.		Clear—do.
	7	38	52	80	94	E.	do.		Cloudy—do.
	8	40	44	90	80	E.	Moderate.	.50	Cloudy—rain
	9	44	57	55	55	W.	Brisk.	.01	Cloudy—shower,
	10	41	51	55	54	W.	do.		Partially cloudy—clear.
🌝	11	42	58	54	54	W.	do.	'	Partially cloudy—do do.
	12	33	52	90	98	W.	do.		Clear—flying clouds.
	13	36	54	30.05	30.06	W.	Moderate.		Clear—cloudy
	14	40	43	29.94	29.96	NE.N.	do.	.04	Lightly cloudy—rain and snow.
	15	30	48	30. 3	90	SW.	do.	.06	Clear—cloudy—snow.
	16	30	41	29.95	30.10	NW.	do.		Clear—lightly cloudy.
	17	30	43	30.20	15	E.S.	do		Cloudy—do.
	18	44	65	29.75	29.60	SW.	Brisk.	1.46	Cloudy—rain with thunder.
☽	19	44	55	54	55	W.	do.		Cloudy—flying clouds.
	20	29	42	90	93	W.	do.		Clear—lightly cloudy.
	21	26	46	30.15	30.15	N.W.	do.	-	Clear—lightly do.
	22	38	68	29.65	29.65	SW.	do.		Cloudy—do.
	23	41	58	80	84	E.W.	Moderate.		Clear—cloudy.
	24	38	42	90	95	E.	do.	.40	Snow—hail—rain.
⊗	25	32	43	30.00	30.05	NE.	do.		Cloudy—do.
	26	37	52	29.85	29 70	E.	do.	.12	Cloudy—rain.
	27	48	62	60	70	W.	do.		Flying clouds—clear.
	28	53	75	75	65	NE.	do.	.26	Cloudy—thunder shower.
	29	52	72	55	55	NW.W.	Brisk.		Cloudy—flying clouds.
	30	42	50	90	95	W.	do.		Clear—clear.
	Mean	38.10	52.96	29.79	29.79			2.87	

	Thermometer.	Barometer.
Maximum height during the month.	75.00 on 28th.	30.20 on 17th.
Minimum " " "	26.00 on 21st.	29.54 on 10th, 11th, 19th.
Mean	45.53	29.79

JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

AUGUST, 1838.

Practical and Theoretical Mechanics and Chemistry.

Brief observations on Common Mortars, Hydraulic Mortars, and Concretes. By J. G. Totten, *Lt. Col. of Eng. and Brevet Col. United States Army.*

(Continued from p. 26.)

Article xxv.—*Some recent experiments with Mortars made of Lime and Sand.*

There will be presented, in conclusion, some experiments, made very recently at Fort Adams, with lime mortars without cement; they were instituted in reference to the best proportions of lime and sand, and also to a comparison of coarse and fine sand, and salt and fresh water.

In making these, a cask of fresh Smithfield lime, of the best quality, was taken, and the lumps broken into pieces of about the size of a pigeon's egg. These being carefully screened, in order to get rid of all dust and fine lime, and carefully intermixed, in order to obtain uniformity of quality throughout, were slaked by the affusion of water to the amount of one third the bulk of lime. When cold, the slaked lime was returned to the barrel, which was carefully headed and put in a dry place; and on all occasions of withdrawing a portion of this lime for use, the cask was carefully re-headed.

The sands used were those described in page 4, as sand No. 1, sand No. 2, sand No. 3, and sand No. 4.

In making the mortars, just enough water was added to the slaked lime taken from the cask, to make a stiff paste. This paste being passed through a hand paint mill, which ground it very fine, was mixed, by careful manipulation, with the due proportions of sand. Much care was bestowed upon the operation of filling the prism-moulds with mortar; and each prism was submitted to a pressure of 600 lbs. for a few minutes, that is to say while the succeeding prism was being formed.

About one week was consumed in preparing the prisms—namely, from

the 7th to the 15th of May, 1838. And they were broken on the 1st of July, 1838, making the average duration of the experiment, 50 days.

Three prisms were made of each composition. But, on the principle that there are several causes which tend to make a prism weaker than it should be, and few or none that tend to make it stronger, only the maximum result of each experiment is given in the following table.

It may, however, be well to state that precisely the same inferences are deduceable, if the mean of the results be taken instead of the maximum.

Table No. LXX.

Trials made on the 1st of July, 1838 of the strength of the mortars made between the 7th to 15th of May, 1838 (50 days.) The results show the weights, in pounds, required to break prisms of mortar 6 inches long, by 2 inches by 2 inches: the distance between the supports being 4 inches, and the power acting midway between the supports.

Composition of the mortars.	Sand No. 1.—Lime. Fresh water.	Sand No. 2.—Lime. Fresh water.	Sand No. 3.—Lime. Fresh water.	Sand No. 4.—Lime. Fresh water.	Sand No 1.—Lime. Salt water.	Sand No. 3.—Lime. Salt water.
Lime in stiff paste 1—Sand 0	262½					
do. 1 do. ¼	224	220½	248½	353½	192½	234½
do. 1 do. ½	213½	234½	234½	241½	210	199½
do. 1 do. 1	248½	220½	227½	234½	178½	178½
do. 1 do. 2	164½	199½	161	178½	140	178½
do. 1 do. 3	157½	189	185½	157½	119	119
do. 1 do. 4	126	227½?	157½	136½	101½	154

Observations on the experiments of table No. LXX.

1st. Within the limits of the experiments, the mortar was the stronger as the quantity of sand was the less—in 96 comparisons, 12 exceptions.

2nd. Although the above inference is derived from the whole range of the table, still, when the quantity of sand was less than the quantity of lime, the weakening effect of the sand on the mortar was not very sensible. And it would seem from table No. LXV. that from one-fourth to one-half of sand may be slightly beneficial.

3rd. It appears that coarse sand, or, rather, sand composed of coarse and fine particles, (sands No. 1 and 2,) is a little inferior to sand that is all fine (sands No. 3 and 4;) in 36 comparisons, 16 exceptions; and also that sand reduced by pounding to a fine powder (No. 4,) afforded some of the best results of the table. It is to be regretted that no experiments were instituted in order to compare sand all coarse, with sand all fine.

4th. It appears that the mortars made with salt water—that is to say, the water of the ocean, was decidedly weaker than those made with fresh water; 1 exception in 12 comparisons. The aggregate strength of all the

prisms made of coarse sand and salt water was 2674 lbs.; while the aggregate strength of the corresponding prisms of coarse sand and fresh water was 3174 lbs. And the aggregate strength of all the prisms of fine sand and salt water was 2800lbs. while the aggregate strength of the corresponding prism of fine sand and fresh water was 3346 lbs.

Description of the Plates.

PLATE I.

Fig. 1. *a*, *a*, Prism of mortar under trial.
b, *b*, Iron stirrups, supporting the prism.
c, *c*, Iron collar, embracing the prism.
d, *d*, Iron link, to which the ropes of the scale-pan are fastened.
e, *e*, check, against which the collar rests when on the middle of the prism.
f, *f*. Timber, to which the stirrups are attached.
g, Scale pan, in which the weights to break the prism are put.
Fig. 2. *h*, Interior of the furnace.
i, Door of the furnace.
k, *k*, Chimney.
l, Register.
m, *m*. Arches, under the hearth, in which the fuel is placed.
n, *n*, Conduits, to lead the flame and a current of air into the furnace.
Fig. 3. *o*, Plan of lime kiln.
p, *p*, Nut of the kiln.
q, *q*, Steps descending to the doors of the kiln.
r, Steps, up which the materials are carried to the top of the kiln.
s, *s*, Doors of the kiln.
t, *t*, Portions of spherical arches leading to the doors of the kiln.

PLATE II.

Figs. 4, 5, 6, 7 and 8, represent Mr. Petot's "*curves of energy*" of fat lime, hydraulic lime—plaster-cements—calcareous puzzolanas, and clay.
Fig. 9. *a*, *b*, Half staples, driven into the floor.
f, *g*, A pair of bricks united by mortar.
c, *c*, Iron piece, embracing the ends of the upper brick, and suspended from the steelyard.
d, Steelyard.
e, Bucket, into which sand flowed from the trough.
h, Trough.
i, Floor.
Fig. 10. *a*, *b*, *c*, Iron lever, with a steel point at *a* to impress the mortar *f*, on the brick *g*.
d, Steelyard, connected with the lever *a*, *b*, *c*, at *c*.
e, Iron rod, from which the steelyard is suspended.
h, *h*, Uprights, supporting the rod *e*.
i, Uprights of iron, supporting the fulcrum of the lever *a*, *b*, *c*.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Note on the Solar Eclipse of May 15th, 1836, *by* SEARS C. WALKER.

In the Journal of the Franklin Institute, vol. xvii, p. 246, 1836, I have given the formulæ for the ready announcement of the phases of this eclipse, and in vol. xviii, p. 97, a modification of the same for determining the longitude from Greenwich, of places of observation near Philadelphia. The arrival of the European observations and computations relative to this eclipse, has furnished the means of reducing the observations made in this country, and of determining longitudes with an accuracy nearly equal to that of the observations themselves. There are two principal methods by which such computations are made. The first, which is the one generally employed in this century, consists in deducing from the observation the local time of new moon; then the difference of the local times of the same event are taken for the difference of longitude of the places of observation. But since the errors of the tables affect these local times of new moon differently at different places, allowance must be made therefor to obtain the true differences of longitude.

The European observations of this eclipse have been reduced in this manner by a distinguished astronomer, C. Rümcker, of Hamburg. His computations have furnished him the following approximate corrections of the elements of the eclipse as given in the Berlin Jahrbuch.

$$
\begin{array}{lrl}
(1)\cdots & \Delta\beta = & -7.''63 = \text{cor. moon's tab. latitude.} \\
& \Delta(\odot + ☽) = & -1.''00 = \text{cor. tab. sum of semidiameters.} \\
& \Delta(\odot - ☽) = & -2.''00 = \text{cor. tab. difference.} \\
& \Delta\pi = & 0.''00 = \text{cor. moon's tab. parallax.}
\end{array}
$$

These corrections he has left subject to a more full discussion when a greater number of observations is obtained. Rümcker's computations are published in Schumacher's Astronomical Notices, No. 319. A translation of them may be found in the London & Edinburgh Philosophical Magazine, vol. x, p. 180, 1837, with the formulæ by which they are made. These formulæ are given more at length in this author's interesting paper on the solar eclipse of the 3—4 March 1840, (received through the politeness of Prof. A. D. Bache) which is one of the best models yet published of this method of reducing the observations of a solar eclipse.

The second method consists in making the unknown quantity the longitude sought, and in deducing from the observations, an approximate value for this longitude to be afterwards corrected for the effect of the errors of the tables, which, as in the other method is different at different places. This method founded on the fundamental equation of eclipses originally published by Lagrange in the Berlin Jahrbuch, for 1782, was first given to the world by Bessel in the Astronomical Notices, No. 151 and 152, and received from its author, the finishing hand in 1836 in a paper No. 321, on the then recent eclipse of May 15th. In reading these papers we are astonished at the genius of the analyst who has succeeded in giving a new and more perfect form to the method of reducing this kind of observations, as he has by his former works to most of the computations in practical astronomy. Mr. Bessel here reduces the principal corrections of the tabular errors to the three following, viz: of the moon's tabular place on the orbit—

—on a perpendicular to the orbit—and of the sum or difference, of the un's and moon's assumed semidiameters; which he denotes severally by ι, ζ, and η or η'. He also points out an error to which many of the reductions of eclipses and occultations by the old method have been liable where the longitude is not well ascertained—and which, where the duration is short, may wholly vitiate the result. This source of error consists in the assumption of the constancy of the moon's latitude or declination during a time equal to the required correction of the assumed longitude.

A complete discussion of the European observations after Bessel's method, is given by H. C. F. Peters, in No. 326, of the Astronomical Notices. From them he deduces the following corrections of the elements derived from the Berlin Jahrbuch.

$$(2)\cdots \quad \iota = -3.''650 - 0.0082\eta' + 0{,}0007\eta$$
$$\zeta = -5.''472 - 0.1590\eta'$$

Where

$$\eta = \triangle(\odot + \rangle) \text{ of Rümcker nearly.}$$
$$\eta' = \triangle(\odot - \rangle) \text{ " " "}$$

This value of ζ is derived from the observed duration of the ring at Braunsburg, Pillau, Rostock, Stralsund and Copenhagen (Round Tower.) That of ι is derived from the observations of the beginning and end at Altona, Berlin, and Königsberg. The coefficients of η and η' are so small that no sensible error can arise from neglecting them. To change ι and ζ into right ascension and declination, recourse may be had to Bessel's formulæ. Astr. Nachr. vol. x, p. 138.

$$(3)\cdots \quad \iota = \sin. N. \cos. \delta \triangle \alpha. + \cos. N. \triangle \delta$$
$$\zeta = -\cos. N. \cos. \delta \triangle \alpha. + \sin. N. \triangle \delta - \varkappa \cos. \varpi \triangle \varpi$$

Whence

$$^*(4)\cdots \quad \triangle \alpha = [\iota \sin. N. - \zeta \cos. N. - \varkappa \cos. N. \cos. \varpi \triangle \varpi] \sec. \delta$$
$$\triangle \delta = \iota \cos. N. + \zeta \sin. N. + \varkappa \sin. N. \cos. \varpi \triangle \varpi$$

The moon's nearest approach to the sun in her true orbit, takes place at 3h mean time Berlin, nearly. For this time I find from Peters' co-ordinates and the elements in the Berlin Jahrbuch.

$$(5)\cdots \quad \varkappa = 0.47147 = L. \sin. 1.'' \operatorname{cosec.} \varpi$$

L = least distance of centres in true orbit in seconds of arc.

$N = 70° 11' 10.''4$ = moon's orbital angle.

$\delta = 19° 22' 40.''3$ = moon's true declination.

$\alpha = 52° 13' 48.''2$ = moon's true R. ascension.

$\varpi = 54' 24.''1$ = moon's horizontal equatorial parallax.

The equations (2) and (4.) with the values in (5) give,

$$(6)\cdots \quad \triangle \alpha = -1.''6794 - 0.1693 \times \triangle \varpi$$
$$\triangle \delta = -6.''3844 + 0.4436 \times \triangle \varpi$$

Calling the corrections of the moon's tabular longitude $\triangle\lambda$, Airy's formulæ, Greenwich observations for 1836, for changing $\triangle \alpha$ and $\triangle \delta$ into $\triangle \lambda$ and $\triangle \beta$, are,

*Bessel ibid. p. 140, omits the terms containing $\triangle \varpi$ I have found it necessary to retain them in comparing together the results by the two methods.

$$(7)\cdots \quad \Delta\lambda = \frac{P}{15}.\Delta\alpha + Q\Delta\delta$$
$$\Delta\beta = \frac{R}{15}.\Delta\alpha + S\Delta\delta$$

Also in his tables of these coefficients we find from the arguments α and δ in (5.)

$$(8)\cdots \quad \frac{P}{15} = +0.9147$$
$$Q = -0.2440$$
$$\frac{R}{15} = +0.2313$$
$$S = +0.9690$$

and from (6,) (7) and (8,)

$$(9)\cdots \quad \Delta\lambda = +0.''0214 - 2.6311 \times \Delta\pi$$
$$\Delta\beta = -6.''5740 + 0.3906 \times \Delta\pi$$

The mean of Rümcker's equations of condition from the observed beginning and end, at Altona, Hamburg, Copenhagen, Bremen, and Berlin, give,

$$(10)\cdots \quad \Delta\lambda = -2.''074 - 0.0630 \times \Delta'\beta + 0.0005 \times \Delta'(\odot + \rightmoon) - 0.5849 \times \Delta'\pi$$
$$\Delta\beta = -7.''630 + \Delta'\beta$$
$$\Delta(\odot + \rightmoon) = -1.'' + \Delta'(\odot + \rightmoon)$$
$$\Delta\pi = 0 + \Delta'\pi$$

Where an accent over the Δ denotes a further correction of Rümcker's approximate values in (1.) The values of the corrections derived from the two computers in (9) and (10,) will coincide when we make,

$$(11)\cdots \quad \Delta'\beta = +1.474$$
$$\Delta'(\odot + \rightmoon) = -0.''112$$
$$\Delta'\pi = +1.''069$$

Whence

$$(12)\cdots \quad \Delta\lambda = -2.''791$$
$$\Delta\beta = -6.''156$$
$$\Delta(\odot + \rightmoon) = -1.''112$$
$$\Delta\pi = +1.''069$$

The coincidence, of the results of these independent computations by methods wholly different, removes all probability of error in either. Bessel's method, however, appears more simple, inasmuch as the corrections of the place of the moon are reduced to two unknown quantities ε and ζ which are derived with greater facility and accuracy from the equations of condition, than the three unknown quantities $\Delta\lambda$, $\Delta\beta$, $\Delta\pi$, referred to in the old method. Accordingly I have adopted Bessel's method and Peters' corrections in reducing the American observations.

The importance of this eclipse for perfecting our geography, from the number and accuracy of its observations at home and abroad, is such that I have thought it useful to append a table of the final results from all the observations. Those from the European are taken from Peters' paper. Those from the American, were computed by myself first from Bessel's formulæ, Astr. Nachr. No. 152, and afterwards re-computed from Peters' co-

ordinates for the end, and mine for mean noon Berlin for the beginning. The second computations, however, gave no other change in the final results than that which arises from a change in the sun's mean semidiameter, which in Bessel's paper, No. 319, is derived from his reduction of the observations of the transit of mercury over the sun's disc in 1832, and is 1.″112 smaller than that which is derived from transit observations of the sun's limbs, which are believed to be affected by the irradiation of the telescope.

In the table below, m is the resulting longitude + east — west from Greenwich, affected by the errors of the elements in the Berlin Jahrbuch, the sun's semi-diameter being diminished 1.″112; a, b, and c, are the coefficients of the three principal corrections ι, ζ, and η or η'; so that d being the longitude corrected for these errors we have,

$$d = m + a\,\iota + b\,\zeta + c\,\eta$$

It is found impossible to assign any value of η or η', which will satisfy all the observations, or even those made at the same place by different observers; indeed this value depends upon the size of the telescope, the power used, and the nice adjustment of the focal distance for the eye of the observer. Omitting this correction and making,

$$d' = m + a\,\iota + b\,\zeta = m - 3.''650 \times a - 5.''472 \times b$$

we have the value of d' in the table below, which is the most probable longitude of the places of observation from Greenwich that can be deduced from this eclipse. I will here take occasion to remark that x in my former paper in vol. xviii. page 9, 1836, is equivalent to $a\,\iota + \frac{1}{2}(b, + b')\,\zeta$ or to the half sum of corrections for the errors of the tables, for the beginning and end of the eclipse. The mean of the Philadelphia observations gave from an assumed longitude of 5h. 0m. 40s., a result which compares with Peters' correction as follows,

$x = -$ 11.04s. by my computations.
$x = -$ 10.60s. by Peters' "

a co-incidence which confirms the accuracy of the assumed longitude of the State House; indeed the mean of all the Philadelphia observations compared with the European, gives,

Longitude of State House = 5h. 0m. 39.6s.

To this result great weight should be attached; for we have five good observations of beginning and end here, and an ample number in Europe. I deem it proper in this place to add that the error of the three chronometers used at the Philosophical Hall, 100 South 8th street, and at T. M'Euen's house, were determined from comparison together immediately after the eclipse, and from my transit observations of the sun, and of stars in the evening following, checked by Eastern and Western altitudes of the sun, by two observers, Mr. Riggs and myself, with different sextants; the transit observations were corrected for instrumental deviations; so that the chronometers were not liable to an error of more than 0.4s. Mr. Sellers' observations were made with his own clock by Lukens, which has few superiors in any country, and its error was determined by Mr. Sellers' transit instrument by Young, and agreed with that furnished by my observations, after allowing for the difference of meridians.

The table of reduced observations, is here subjoined, the last column d' is the longitude from Greenwich, derived from the observation.

Place of observation.	Mean time of observation.	m	a	b	c	d'
	h m s					m s
Altona, *Schuma-*	2 43 50.8B	+39 53.18	+2.158	−0.112	+2.161	+39 45.92
cher and *Son.*	5 21 23.2E	+39 54.40	+2.159	−0.055	−2.160	+39 46.82
Apenrade,	2 40 38.4B	+38 17.43	+2.158	−0.021	+2.158	+38 9.67
Hansen & *Fischer.*	4 0 5.6BR	+37 57.78	+2.159	−0.063	+2.159	+38 50.25
	4 4 23.1ER	+37 50.87	+2.159	−0.094	−2.161	+37 43.50
Berlin,	3 2 43.8B	+53 41.91	+2.158	−0.181	+2.165	+53 35.03
Encke.	5 37 31.9E	+53 46.18	+2.160	−0.040	−2.160	+53 38.52
Bern,	2 37 8.6B	+30.16.64	+2.158	−0.529	+2.222	+30 11.66
Treschel.	5 16 48.2E	+29 49.47	+2.160	+0.342	−2.187	+29 39.72
Braunsburg,	3 33 40.2B	+79 43.02	+2.158	−0.061	+2.159	+79 35.48
Feldt and *Becker.*	4 49 23.6BR	+79 35.65	+2.159	+1.277	+2.508	+79 20.79
	4 52 34.2ER	+79 14.64	+2.159	−1.647	−2.715	+79 15.78
	6 1 40.1E	+79 20.91	+2.159	−0.214	−2.170	+79 14.19
Bremen,	2 38 12.0B	+35 18.41	+2.158	−0.102	+2.160	+35 11.09
Cluver and *Wolf.*	5 16 56.9E	+35 17.37	+2.159	−0.018	−2.160	+35 9.58
Bremerhafen,	2 37 27.0B	+35 0.63	+2.158	−0.109	+2.160	+34 53.35
Thulesius.	5 15 27.0E	+34 30.51	+2.159	−0.033	+2.160	+34 22.81
Brussels,	2 16 0.4B	+17 36.32	+2.158	−0.255	−2.173	+17 29.84
Quetelet.	4 59 47.3E	+17 37.49	+2.159	+0.152	+2.165	+17 28.78
Copenhagen, (Hol-	2 55 52.8B	+50 31.21	+2.158	+0.010	+2.158	+50 23.28
ken's, Bastion,)	4 15 53.2BR	+51 2.76	+2.159	+3.580	+4.180	+50 35.29
Pedersen.	5 29 32.9E	+50 11.19	+2.159	−0.193	−2.168	+50 4.36
Copenhagen,	2 56 3.7B	+50 39.89	+2.158	+0.011	+2.158	+50 31.96
(Round Tower)	4 15 37.1BR	+50 49.02	+2.159	+3.618	+4.213	+50 21.35
Olufsen.	5 29 32.9E	+50 11.88	+2.159	−0.193	−2.168	+50 5.05
(*)	5 33 43.0E	+48 9.9[illegible]	+2.160	+0.062	−2.160	+48 1.74
(†)	4 39 12.3E	+ 10.59	+2.159	+0.158	−2.165	+ 1.84
Halifax,	1 39 8.0B	− 8 12.97	+2.158	−0.027	+2.158	− 8 20.69
Waterhouse.	4 27 7.0E	− 8 14.57	+2.159	+0.043	−2.160	− 8 22.68
Hamburg, *Rüm-*	2 44 6.3B	+40 5.25	+2.158	−0.112	+2.161	+39 57.99
cker and *Peters.*	5 21 30.5E	+40 1.45	+2.160	−0.055	−2.160	+39 53.86
Hanover,	2 43 49.0B	+39 7.64	+2.158	−0.183	+2.165	+39 0.77
Lahmayer.	5 21 48.7E	+38 59.05	+2.159	+0.010	−1.159	+38 51.12
Jena, *Schrön.*	5 31 35.0E	+46 31.29	+2.160	+0.065	−2.161	+46 23.04
(‡)	3 36 19.2B	+82 8.81	+2.158	−0.040	+2.158	+82 1.16
	6 3 58.7E	+82 4.14	+2.159	−0.239	−2.173	+81 57.57
London,	1 51 13.0B	+ 0.04	+2.158	−0.182	+2.165	+ 6.84
Simms, jr.	4 38 47.0E	− 10.21	+2.159	+0.152	−2.165	+ 18.95
Louvain,	2 17 37.3B	+19 18.65	+2.158	−0.249	+2.172	+19 12.16
Crahay.	5 0 52.6E	+18 37.29	+2.159	+0.147	−2.164	+18 28.61
Makerstown,	1 36 51.2B	− 9 39.71	+2.158	+0.081	+2.159	− 9 48.02
Brisbane.	3 1 4.2BR	− 9 35.22	+2.158	+0.143	+2.163	− 9 43.88
	3 5 11.6ER	− 9 55.48	+2.158	−0.129	−2.162	−10 2.69
	4 23 0.6E	− 9 54.45	+2.159	−0.056	−2.160	−10 2.02
Neumühlen,	2 43 54.4B	+39 55.85	+2.158	−0.112	+2.161	+39 48.60
Zahrtman.	5 21 20.6E	+39 51.86	+2.159	−0.055	−2.160	+39 44.28
Neustrelitz,	3 0 29.0B	+52 32.86	+2.158	−0.130	+2.162	+52 25.70
Lorentz & *Becker.*	5 34 58.0E	+52 19.40	+2.160	−0.079	−2.161	+52 11.95

*Gera, *Metz* and *Engelhardt.*
†Greenwich, *Airy* and four others.
‡Königsberg, *Bessel, Son* and *Busch.*

Place of observation.	Mean time of observation.	m	a	b	c	d′
	h m s	h m s				
Pillau,	4 49 56.5PR	+ 79 57.09	+2.159	+2.533	+3.328	+ 79 35.35
Schwink.	4 51 57.6ER	+ 79 24.73	+2.159	−3.117	−3.791	+ 79 33.91
Rostock,	2 54 43.1R	+ 48 36.43	+2.158	−0.083	+2.159	+ 48 29.01
Karsten.	2 14 19.7BR	+ 48 36.18	+2.159	−1.965	+2.919	+ 48 39.05
	4 17 58.2ER	+ 48 48.45	+2.159	+1.596	−2.684	+ 48 31.85
	5 29 58.2E	+ 48 33.24	+2.159	−0.107	−2.162	+ 48 25.95
(*)	1 51 52.1B	+ 27.40	+2.158	−0.185	2.165	+ 20.54
	4 39 20.1E	+ 16.66	+2.159	+0.158	−2.165	+ 7.92
Steltin,	3 7 51.7B	+ 58 22.61	+2.158	−0.126	+2.161	+ 58 15.43
Dancke.	5 41 16.3E	+ 58 23.51	+2.160	−0.101	−2.162	+ 58 16.18
Stralsund,	2 59 44.2B	+ 52 40.02	+2.158	−0.071	+2.159	+ 52 32.54
Steinort.	4 18 7.0BR	+ 52 24.17	+2.159	−0.865	+2.325	+ 52 21.03
	4 22 26.6ER	+ 52 33.00	+2.159	+0.613	−2.244	+ 52 21.77
	5 33 49.2E	+ 52 27.62	+2.159	−0.103	−2.163	+ 52 20.30
Strasburg,	2 36 45.1B	+ 31 15.48	+2.158	−0.419	+2.198	+ 31 9.90
Herrenscheider.	5 16 44.9E	+ 30 53.41	+2.160	+0.243	−2.173	+ 31 44.20
Tondern,	2 37 15.0B	+ 35 37.44	+2.158	−0.026	+2.158	+ 35 29.71
Petersen.	3 57 26.7BR	+ 35 37.16	+2.159	−0.837	+2.193	+ 35 31.38
	4 1 48.1ER	+ 35 35.29	+2.159	+0.229	−2.171	+ 35 26.16
	5 14 51.0E	+ 35 32.60	+2.159	−0.117	−2.163	+ 35 25.36
(†)	5 54 37.1E	+ 65 36.52	+2.160	+0.148	−2.165	+ 65 27.82
(‡)	2 47 4.0B	+ 39 52.34	+2.158	−0.337	+2.184	+ 39 46.30
	5 32 40.0E	+ 47 40.87	+2.160	+0.053	−2.160	+ 47 32.69
Washington, (Cap-	18 53 58.0B	−5 7 53.26	+2.157	+1.242	+2.489	−5 8 7.92
itol,) *Hassler.*	21 20 8.0E	−5 8 12.46	+2.158	−0.252	−2.172	−5 8 18.99
Haverford Pa.,	19 3 24.5B	−5 0 51.82	+2.157	+1.232	+2.484	−5 1 6.43
I. Gummere.	21 31 47.0E	−5 1 17.12	+2.158	−0.249	−2.171	−5 1 23.67
Germantown,	19 3 55.5B	−5 0 23.65	+2.157	+1.229	+2.482	−5 0 38.25
C. Wistar.	21 32 49.5E	−5 0 34.66	+2.158	−0.232	−2.170	41.26
Germantown,	19 3 54.5B	−5 0 24.77	+2.157	+1.229	+2.482	39.37
I. Lukens.	21 32 44.5E	−5 0 38.18	+2.158	−0.232	−2.170	44.78
§State House,	19 3 38.0	−5 0 25.41	+2.157	+1.227	+2.481	−5 0 39.99
Phila. *T. M'Euen.*	21 32 38.1	33.20	+2.158	−0.252	−2.171	39.82
State House,	19 3 50.0	13.14	+2.157	+1.226	+2.481	27.72
W. H. C. Riggs.	21 32 26.5	41.43	+2.158	−0.232	−2.170	48.04
State House,	19 3 40.9	24.66	+2.157	+1.225	+2.481	39.24
S. C. Walker.	21 32 44.1	30.86	+2.158	−0.228	−2.170	37.48
State House,	19 3 45.8	20.42	+2.157	+1.225	+2.481	34.90
R. M. Patterson.	21 32 38.3	35.93	+2.158	−0.229	−2.170	42.57
State House,	19 3 41.0	25.00	+2.157	+1.225	+2.481	39.47
S. Sellers.	21 32 34.0	39.46	+2.158	−0.229	−2.170	46.80
(¶)	19 12 48.5	−4 53 12.11	+2.157	+1.203	+2.451	−4 53 26.66
	21 43 40.0	−4 53 50.70	+2.158	−0.206	−2.170	−4 53 57.45
Southwick, Mass.	19 17 52.2	−4 50 51.9	+2.157	+1.226	+2.463	−4 51 6.53
Holcomb.	21 49 20.1	−4 51 13.36	+2.158	−0.231	−2.170	−4 51 19.97

*Shooter's Hill, *Hodgson. Simms, jr., Simms, sen.* and *Gilby.*

†Vienna, *Hallascha, J. J. Littrow, C. J. Littrow, Böhn, Brestel.*

‡Wurtzburg, *Schoen, J. Zeitz.*

‖The observation at Pillau is affected with the clock's error.

§The values of *m* and *d′* for the Philadelphia observations are reduced to the State House.

¶West Hills, (Coast Survey,) *Ferguson.*

§A highly interesting memoir on a remarkable phenomenon which occurs in total and annular eclipses, by Francis Bailey, Esq., Vice President of the Royal Astronomical Society, has been published in the 10th volume of the memoirs of that society. I have appended an extract from this memoir, describing this phenomenon as observed by Mr. Bailey, at Inch Bonney, Lat. 55° 27′ 30″, Long. 10m 12s.0 west of Greenwich, situated in the path of the centre of the annular eclipse of May, 1836. For the early receipt of a copy of this memoir from the author, I am indebted to the attentions of Prof. Alex. Dallas Bache. It is hoped that the annular eclipse of Sept. 18th, 1838, will, if the weather permits be observed with reference to the phenomenon described by Mr. Baily. The city of Washington, near its central path, will afford an excellent position for observation. The computations of R. T. Paine Esq., in the American Almanac, or the formulæ for the announcement of its principal phases with the geographical limits of the annular phase, in E. O. Kendall's paper published in the Journal of the Franklin Institute vol. xx p. 125, will serve as a guide to observers in the choice of a favourable position. The last annular eclipse of the sun observed at this place was by Rittenhouse, April 3rd, 1791. From inspection of Mr. Paine's list of eclipses for the rest of the century, in the American Almanac for 1831, pages 70 to 76, it does not appear that any other annular eclipse will occur at this place in the 19th century.

I. *On a remarkable Phenomenon that occurs in Total and Annular Eclipses of the Sun. By* Francis Bailey, Esq., *Vice-President of this Society, &c. &c.*

The following are the observations as shewn by one of the chronometers, adjusted, from a mean of all the comparisons, to the correct mean time at Inch Bonney.

Beginning of the eclipse	1h	36m	44s	
Formation of the annulus	3	0	57	subject to discussion.
Dissolution of the annulus	3	5	23	See page 159.
End of the eclipse	4	23	7	

The diminution of light was not so great, during the existence of the annulus, as was generally expected; being little more than might be caused by a temporary cloud passing over the sun: the light however was of a peculiar kind, somewhat resembling that produced by the sun shining through a morning mist. The thermometer in the shade fell only about three or four degrees: it was 61° during the time of the annulus. About twenty minutes before the formation of the annulus, *Venus* was seen with the naked eye: and a few minutes afterwards I found it impossible to fire gunpowder with the concentrated rays of the sun through a lens of three inches in diameter. The same lens likewise had no effect on the bulb of a thermometer, during the existence of the annulus. Similar results also were obtained by Sir Thomas Brisbane.

As preceding writers have noticed the tendency of the birds of the field and of the poultry, to go to roost during the darkness occasioned by a great eclipse, I would here remark that nothing of the kind occurred on this occasion in the district where I was placed.* On the contrary the birds in the hedges were in full song during the whole time of the eclipse: and I noticed to Mr. Veitch that one cock in particular, in a neighbouring farm-yard

*This supposed *darkness* has always been overrated, even in total eclipses. The light which remains, after the sun is wholly covered, is sometimes as great as that of the *full moon*.

was crowing with all his might, whilst we were observing the remarkable phenomenon of the annulus.

Having made these general remarks I shall now proceed to detail those singular appearances which occurred at the formation and dissolution of the annulus; and which have never yet, as far as I have been able to ascertain, been described in a complete and connected manner, in any preceding accounts. For, although detached portions of the phenomenon have been recorded by different observers, as seen at different places, yet it is impossible, from those descriptions, to form an accurate idea of the *whole*, or to trace the origin, progress, and termination of that remakable phenomenon which immediately precedes the complete formation of the annulus, and which again takes place (but in an inverse order) immediately after the commencement of the dissolution of the annulus. In fact, since the phenomenon itself, during its short period of existence, constantly varying in some minute particulars, no description of any one detached portion of it will enable us to judge of the remainder: and thus the partial accounts of different observers (alluding probably to different stages of the phenomenon) become confused and perplexing.

The weather at Inch Bonney was remarkably favourable for observation: the sky was perfectly clear and serene; not a cloud to be seen in any part of the heavens, during the whole time of the eclipse. When the last portion of the moon's disc was about to enter on the face of the sun, I prepared myself to observe the formation of the annulus. I was in expectation of meeting with something extraordinary; but imagined that it would be momentary only, and consequently that it would not interrupt the noting of the time of its occurrence. In this, however, I was deceived, as the following facts will shew. For when the cusps of the sun were about 40° asunder, a row of lucid points, like a string of bright beads irregular in size and distance from each other, *suddenly* formed round that part of the circumference of the moon that was about to enter, or which might be considered as having just entered, on the sun's disc. Its formation indeed was so rapid that it presented the appearance of having been caused by the ignition of a fine train of gunpowder. This I intended to note as the correct time of the formation of the annulus, expecting every moment to see the thread of light completed round the moon; and attributing this serrated appearance of the moon's limb (as others had done before me) to the lunar mountains, although the remaining portion of the moon's circumference was comparatively smooth and circular, as seen through the telescope. (See fig. 1.) My surprise however was great on finding that these luminous points, as well as the dark intervening spaces, increased in magnitude, some of the contiguous ones appearing to run into each other like drops of water: for, the rapidity of the change was so great, and the singularity of the appearance so fascinating and attractive, that the mind was for the moment distracted, and lost in the contemplation of the scene, so as to be unable to attend to every minute occurrence. Finally, as the moon pursued her course, these dark intervening spaces (which, at their origin, had the appearance of lunar mountains in high relief, and which still continued attached to the sun's border) were stretched out into long, black, thick, parallel lines, joining the limbs of the sun and moon; when, all at once, they *suddenly* gave way, and left the circumferences of the sun and moon in those points, as in the rest, comparatively smooth and circular; and the moon perceptibly advanced on the face of the sun. This moment, therefore, may, by some persons, be considered as the complete formation of the annulus, and has, I believe, in

most cases, been recorded as such: but I shall state my reasons presently why I think this should not be assumed as the true moment of the astronomical phenomenon.

Fig. 1

Fig. 2

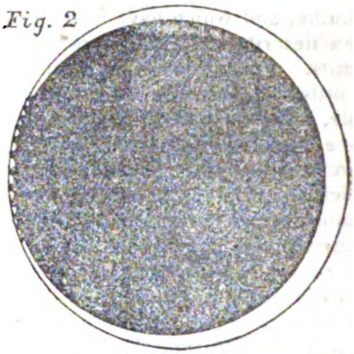


Fig. 3

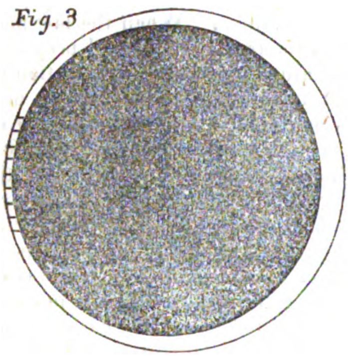
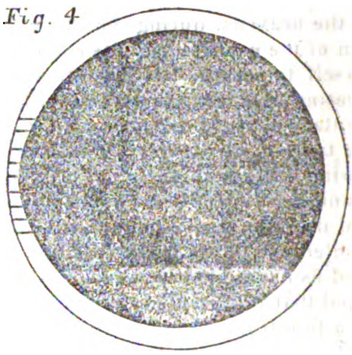


Fig. 4



The appearances here recorded passed off in less time than it has taken me now to describe them; but they were so extraordinary and so rapid, that all idea of time was lost, except by the recollection afterwards of what had passed: for, I was so riveted to the scene, that I could not take my eye away from the telescope, to note down any thing, during the *progress* of this phenomenon. I estimate, however, that the whole took up about six or eight seconds, or perhaps ten at the utmost. In the plate annexed to this memoir, I have endeavoured to delineate the several phases above mentioned, in three of its most striking stages. Fig. 1 represents the first appearance of the luminous string of beads just formed round the edge of the moon; which was almost instantaneous. Fig. 2 represents a *continuation* of the same phenomenon, or the moon further advanced on the face of the sun, but still apparently adhering to its border by means of the dark, thick, irregular spaces which separate the luminous portions, now become somewhat enlarged in size. Fig. 3 represents still a *continuation* of the same phenomenon; the dark parts being now stretched out into long, black, lines which seemed to connect together the limbs of the sun and moon; and are here represented as they appeared immediately before their sudden rupture, and total disappearance. In all these representations on the plate, the moon is supposed to be proceeding in a horizontal direction, from the

left hand towards the right. I cannot describe these phenomena (or rather this phenomenon, for it was one *continuous* appearance) more correctly, than by supposing, for the moment, that the edge of the moon was formed of some dark glutinous substance, which by its tenacity adhered to certain points of the sun's limb, and by the motion of the moon was thus drawn out into long threads, which suddenly broke and wholly disappeared.

After the formation of the annulus thus described, the moon preserved its usual circular outline during its progress across the sun's disc, till its opposite limb again approached the border of the sun, and the annulus was about to be dissolved. When, all at once, (the limb of the moon being at some distance from the edge of the sun) a number of long, black, thick, parallel lines, exactly similar in appearance to the former ones above mentioned, *suddenly darted forward* from the moon and joined the two limbs as before: and the same phenomena were thus repeated, but in an inverse order. For, as these dark lines got shorter, the intervening bright parts assumed a more circular and irregular shape, and at length terminated in a fine curved line of bright beads (as at the commencement) till they ultimately vanished, and the annulus consequently became wholly dissolved.

The time employed in this act of dissolution (if I may so express myself) was about the same as that at its formation: but the rapid and progressive change in the appearances, and their striking character, so riveted my attention again, that I am unable to speak more decidedly on the time occupied, than on the first occasion. The same reason also prevents me from stating the precise number of the dark lines: I should think however that they were not fewer than six nor more than ten. The impression on my mind, from recalling all the circumstances to my recollection, is that there were about eight. They were as plain, as distinct, and as well defined, as the open fingers of the human hand held up to the light.

For the cause of this optical deception I shall not attempt to account. That it does not depend on the instrument employed, or on the eye of the observer, would appear from the concurring testimony of those who witnessed the phenomenon, at various places and with different telescopes, and who yet agree in the main facts here stated. The account given by Veitch, who used a 30-inch refractor, coincided exactly with my own, as compared immediately after the termination of the annulus. The description also by Sir Thomas Brisbane, who used a 2-feet reflector, and whom I visited immediately after the eclipse, agreed in all the essential particulars, and differed only in those points on which I had myself some doubt. Mr. Henderson also, who observed the eclipse at Edinburgh with a 4½-feet refractor, noticed appearances very similar to those which I have here described.

I have been the more particular in making these remarks from having observed that in no one of the published accounts which I have yet seen of this eclipse, is any special notice taken of the remarkable phenomena above alluded to: although, as I shall presently shew, those phenomena, being seen under different circumstances at different places, must materially affect the astronomical results. Or, if any notice has in some instances been taken, the allusion is so slight (being confined principally to the formation of the string of luminous beads, at the very commencement of the annulus,) that few readers would suspect that any thing further remarkable had occurred. I cannot account for this general reluctance to record so singular a phenomenon as that of the dark lines, which

I apprehend could not possibly have passed unobserved by any astronomer.

There is, however, another extraordinary phenomenon, usually accompanying annular eclipses, of a totally different kind from that just described and arising from a totally different cause; and which takes place immediately before the whole body of the moon is projected on the face of the sun. I allude to the arch of faint light, or rather to the luminous edge, which encircles that portion of the moon's border that is *off* the sun's disc. This has been seen on several occasions, as I shall more fully detail in the following pages; but I must confess that I did not myself observe this phenomenon in the present eclipse: a circumstance owing, in the first place, to my attention not having been specially directed to it; and secondly, to my whole time being occupied in looking out for the distinct formation of the annulus. So many interesting objects indeed are crowded into such a short space of time, just at that instant, that there is no opportunity of noting down appearances during their actual occurrence: and the memory must be taxed afterwards for the recollection and description of minute details.

I have already stated that, from the accounts given of preceding annular eclipses, I was led to expect some extraordinary appearances. To those accounts I shall now more particularly refer, not only as confirmatory of what I myself observed on this occasion, but also to shew the imperfect manner in which the phenomenon has been hitherto described, as well as the variety of forms it may assume according to circumstances either accidental or local. For, the position of the spectator, with respect to his distance from the central line, will doubtless cause a difference in the formation, progress, and whole appearance of the phenomenon. A person placed just within the limits of the moon's umbra would probably not witness any of the dark lines to which I have so frequently alluded: but the border of the moon, which in such case just grazes the edge of the sun, would perhaps have a serrated appearance, like lunar mountains of extraordinary height and magnitude; for which indeed they might be readily mistaken at first sight: or would perhaps exhibit only the luminous string of beads, or broader luminous spaces, throughout the whole progress and existence of the annulus. And thus we might have, from this almost imperceptible and unobservable annular appearance, all the intermediate grades up to the extraordinary phenomenon which I have above described. Intervening clouds likewise, just at an unfortunate moment, may in some cases have prevented a full and connected view of each minute occurrence: a circumstance which may in some measure account for the partial and imperfect statements which have hitherto appeared. And I cannot but consider myself as extremely fortunate in having experienced so fine a day for witnessing the whole of the phenomena which I have here recorded.

Before I quit this part of the subject, I wish here to place also on record the appearances which the body of the moon presented during the existence of the annulus. Previous to the formation of the ring, the face of the moon was perfectly black; but on looking at it, through the telescope, *during the annulus*, the circumference was tinged with a reddish purple colour, which extended over the whole disc, but increased in density of colour according to the proximity to the centre; so as to be in that part nearly black. At the same time the globular form of the moon was very perceptible. Mr. Veitch noticed the same circumstances; and we both agreed that the moon

had the appearance of a *globe* of purple velvet. No coruscations were visible on the darker parts, as noticed on former occasions by different observers. During the annulus, being very near sighted, I could not perceive the moon on the face of the sun, with my naked eye: but to Mr. Veitch and others it was distinctly visible.

It is not known at the present day whether, in the annular eclipses of 1736-7, 1748, and 1764, or even in the recent annular eclipse of May last, the times of the moon's total ingress on the sun's disc, be reckoned from the moment when the moon's circumference appears to osculate with that of the sun, or from the moment when the dark lines are seen to part asunder. I believe that most observers have assumed the latter as the most certain and best determined instant of time; although it seems to me not to be the correct moment of the astronomical phenomenon: the former is in my opinion as easily determined if the observer would prepare himself for noting it, and certainly approximates most nearly to the correct time. My own record of the formation and dissolution of the annulus, in page 154, refers to the point of time here alluded to; namely, when the limb of the moon osculated with that of the sun, as nearly as I could estimate and call to mind, amidst the rapid succession of interesting phenomena; and which I consider to be simultaneous with the formation of the luminous string of beads. Both instants, however, ought to be recorded, as in the case of the transits of *Venus:* and in future annular eclipses (as well as in total ones) I trust that this will be attended to. But, the interposition of clouds will sometimes frustrate the best intentions.

This precaution will be the more necessary, since it is plain that the appearances will be different to different observers, according to their local position with respect to the central line of the moon's shadow; as I have already noticed in the preceding part of this paper. And I know some persons who did not notice the dark lines in the late eclipse, although furnished with good telescopes, and favourably situated. This brings me to another portion of the subject to which I have not alluded, namely the distortion of the moon's circular shape: for, hitherto I have considered the phenomenon as remarkable only for certain filaments or projections from the moon's limb, without supposing that the general circular form of the moon was disturbed. In the case of the transit of *Venus*, we have seen that the disc of the planet, next to the edge of the sun, was sensibly protuberant, and that the form of the planet was thus rendered more like that of an egg, than a circle. The same cause that produced this apparent distortion of *Venus'* disc, might also produce a similar distortion in that of the moon; but, by reason of the magnitude of the moon's disc, and the field of the telescope not embracing the whole, it would not be so easily perceptible. There was one circumstance, however, connected with this subject, which I noticed during the late eclipse, that induces me to think that such a distortion did take place on that occasion, and which I shall now proceed to describe.

If we examine the relative curvatures of the circles in fig. 3, which represent the discs of the sun and moon, and note their proximity to each other, it will be seen that there can be no very perceptible difference in the apparent length of the parallel lines, which there denote the dark ligaments so frequently alluded to in this paper, provided those curves truly represented the apparent disc. But, in fact, the outer lines immediately before their rupture seemed to be nearly twice the length of those in the middle, which could arise only from some distortion of the moon's apparent

limb, and of a kind similar to that which had been observed in *Venus.* I have endeavoured to represent this appearance in fig. 4: and if my notion be correct, it will shew us that all measures of the moon's diameter, when she is passing over the sun's disc, must be taken with great caution and with due attention to the proximity of the part measured to the edge of the sun's disc, where alone the distortion seems to take place.

This hypothesis of a distortion of the moon's circular form seems to receive confirmation from a circumstance attending her motion across the sun's disc, when she is *wholly* thereon, which has been noted in annular eclipses by several observers: namely, that at the time of ingress and egress, her motion appears more rapid than at any other point. This apparent increase of motion would arise from the subsidence of the protuberance in the first instance, and from its projection in the latter case.

Another singular anomaly also may arise, from this view of the subject. It is possible that in a small annular eclipse (that is, an eclispe where the apparent diameter of the moon, as computed from the tables, is but a few seconds less than the apparent diameter of the sun) the observer may be so exactly placed on the central line as to see the eclipse *total*, for a moment of time. For, as each portion of the moon's circumference would at the instant that it was concentric with the sun's) protrude, and adhere to that of the sun, the spectator would witness a total eclipse *sine mora*, when in fact he ought only to see an annular one.

It is very probable that the accounts of the appearance of great lunar mountains and valleys which we so frequently hear of in the descriptions of solar eclipses, may be traced to the same cause, as that which produces the phenomena above alluded to. These prodigious elevations and depressions are seldom or never seen except at the commencement or termination of the eclipse, or in places near the solar cusps; that is, in those points only which are near the edge of the sun. Every other portion of the moon's circumference generally appears comparatively smooth and circular, except viewed with a very powerful telescope; whilst with a much inferior instrument we may frequently detect inequalities in those parts of the moon's circumference which successively come in contact with the sun's limb.

This brings me to the consideration of another subject connected with the present inquiry. It has, I believe, been generally supposed that, in eclipses of the sun, the measurement of the distances of the solar *cusps* affords one of the best means of determining the beginning and ending of the eclipse: and, if those cusps always presented a finely pointed apex, this would undoubtedly be the case. But, it is frequently found that the cusps are rounded, or serrated, or broken into parts, and consequently that we cannot obtain the correct measures between the *true points* of the cusps. For which reason we oftentimes meet with discordances in such measures, that have hitherto baffled all attempts at explanation; but which may be fairly attributed to the causes above alluded to. I do not wish however to be considered as objecting to this mode of determining the phases of an eclipse, which, after all, is probably one of the best: but merely as wishing to place the observer on his guard, and to enable him to trace the source of error, should he meet with any of the discordances above mentioned.

It is clear that, before we can deduce the most accurate and accordant results from the observations of annular eclipses, we must have further information on these points, and we must agree on the particular stage of the phenomenon, when the annulus shall be considered as formed, or dissolved: and after all, there will probably still remain some discrepancies arising from the distortion of the moon's limb according to the geographi-

cal position of the spectator. The subject, however, is worthy the consideration of astronomers; and ought not to be neglected at any ensuing solar eclipse that may afford facilities for determining these points.

Franklin Institute.

REPORT OF THE COMMITTEE ON METEOROLOGY.

Report of the Committee on Meteorology to the Board of Managers of the Franklin Institute, embodying the facts collated by the Meteorologist relative to the storm of the 16*th,* 17*th and* 18*th March,* 1838.

As the great storm immediately preceding the Vernal equinox of the present year was one of that class which is supposed to stretch over a wide extent of territory, and to traverse the globe with a determinate direction and velocity, it was believed that an accurate knowledge of its progress and violence at different points would not only prove highly interesting to the cultivators of Meteorological knowledge, but would also tend much to the promotion of the object for which the committee was appointed; with this view the late Joint Committee on Meteorology, of the American Philosophical Society and of the Franklin Institute, issued two hundred and fifty circulars to different parts of the United States and to Canada, asking for information on the various phenomena exhibited by the storm in the respective vicinities.

That the persons addressed might know the precise objects which the committee had in view, it was stated in the circulars, that the committee regarded it as highly important to ascertain the phases of the great storms of rain and snow which traverse our continent, their shape and size, what direction, and with what velocity their centres move along the surface of the earth, whether they are round, oblong, or irregular, in their shape, whether they move in different directions in the different seasons of the year, &c. &c.

To this circular between forty and fifty answers have been received, furnishing a mass of information highly useful and interesting.

These communications were placed in the hands of the Meteorologist for collation, which duty he has performed, as will be seen by his report annexed,

Robley Dunglison, M. D.
Alexander D. Bache,
James P. Espy,
Charles N. Bancker,
John K. Kane,
Henry D. Rogers,
Sears C. Walker,
R. M. Patterson, M. D.
John C. Cresson,
Gouv. Emerson, M. D.

Philadelphia, July, 9th 1838. Committee on Meteorology.

TO THE COMMITTEE ON METEOROLOGY OF THE FRANKLIN INSTITUTE.

Gentlemen:—The following facts comprise some of the most important details collected from the various correspondents. These with additions from other sources are arranged and numbered so as to commence in the Westward, and progress towards the Eastward.

Franklin La. (S. W. of New Orleans,) 29° 50′ N. 91° 50′ W. (From our regular correspondent, a lady.)

Beyond the storm. On the 16th, 17th, 18th and 19th of March, the wind was constantly from the N. high in the mornings, light in the evenings, except the 19th, when it was light in the morning. Clear from the 14th till the afternoon of the 22nd. Slight frost on the 18th and 19th. Barometer rose from the 16th 30.20, till the 17th 30.30, and remained at that till the 20th when it fell again to 30.20.

2. U. S. Hospital, Baton Rouge, La. 30° 29′ N- 91° 27′ W. Observed by W. R. Heiferr, and communicated by A. Wadbeir, Esq.

There was no storm here on the 16th and 17th of March, which were clear fine days, wind strong from N. E. . 18th fine clear day, frost, wind light N. W. 19th wind N. W. strong, cloudy.

3. Natchez, Miss., 36° 34′ N. 91° 25′ W. (From our regular correspondent, Henry Tooley, Esq.)

March 16th hazy, but without a cloud, wind	N.	2	3	6	
17th hazy, very clear "	N. W.	2	3	4	2
18th not a stain on the ethereal blue,	N.	2	W	1	
19th thick haze.	S.	2	SW.	2	1

Barometer on the	16th	29.91
	17th	30.03
	18th	30.05
	19th	29.95

4. Jackson, Miss., 32° 23′ N. 90° 8′ W. (Communicated by the Postmaster.)

There was no rain here from the 11th of March till April.

March 16th, wind's direction and force	N.	2	6	3	
17th, ...	NW.	2	3	4	2
18th, ...	N.	2	W.	1	
19th, ...	S.	2	SW.	1	

5. U. S. Frigate Constellation, Pensacola Bay, lat. 30° 23′ 40″ N., long. 87° 12′ W. (Observed by Dr. Hulse, and communicated by J. H. C. Coffin, Esq.)

This place was beyond the borders of the storm. On the 16th, 17th and 18th of March, the wind was from WNW. to N. and NW. constantly; generally moderate weather; clear, with haze in horizon.

On the 19th the wind was NW. till noon, changeable P. M. to southwardly.

6. Huntsville, Alabama, 34° 36′ N., 86° 57′ W. (From John Allan, Esq.)

We had no storm here at the time mentioned. On the 15th, 16th, 17th and 18th of March, the wind was moderate from the NW. Weather cloudy, with the exception of the 18th, which was clear. On the 19th the wind in the morning was a stiff breeze SE., the remaining part of the day SW.

7. **Nashville, Ten., 36° 10′ N. 86° 49′ W. (From our regular correspondent, Moreau W. Brown, Esq.)**

March 14th, some rain, with change of wind from S. and SW. to NW.

15th, cloudy, clouds passing from N. with moderate wind.

16th, cloudy, with slow rain in forenoon, and occasional showers in the afternoon, mixed with sleet—clouds passing from NW. with brisk wind; becoming colder.

17th, Clouds passing from NW. and N., with brisk wind from NW., partially clear at sunset and after night.

18th, clear, except cirri to E. in the morning, which soon passed off in that direction; wind brisk throughout the day NW.; calm at night.

8. **Grayville, Illinois. (From James Gray, Esq.)**

The weather here on the 16th, 17th, 18th and 19th, was good, except that there may have been a little rain. The wind was, during that time, too gentle to be observed, and therefore I cannot say from what quarter it came.

9. **Warren Court House, Illinois, on the Mississippi river, pretty high up, 40° 50′ N., 90° 50′ W. (From Daniel McNeely, Esq., P. M.)**

We had no storm here. The sky was remarkably clear, and fine weather on the days mentioned, if our memory serves us. On the night of the 15th we had a little snow, and for a few days after a light wind from NW.

10. **Logansport, Ind., (near northern part of the state,) 40° 53′ N., 86° 22′ W. (From D. D. Pratt, Esq.)**

On the 16th, 17th, 18th and 19th of March, the weather here was remarkably fine and warm, and continued so till the 8th of April.

I recollect, however, on the night of the 15th, and during the forenoon of the 16th, a heavy damp snow fell to the depth of several inches, accompanied with a strong wind. I was riding down the Wabash in a direction a little south of west, and I think the wind was blowing nearly in my face. It might have been from a point 25° or 30° south of west.

11. **Elizabethville, Harrison county, Ind. (From E. H. Compton, Esq., observed by John Low, Esq.)**

March 16th, got up before sunrise, found a rainy morning, which early in the day changed to snow, and was attended with the severest storm felt here this season. The snow, notwithstanding the dampness of the ground, fell three or four inches deep. The storm continued till I went to bed at 8, P. M.; wind from the NNW., the point from which it blew all day.

17th, left my bed at day break, found it still cloudy, with considerable wind. It was partially clear through the day, and the wind came round to NNE.

18th, at day break, found it clear, but somewhat cold; moderated, became pleasant, and remained so all day, and wind changed to ESE., quite calm.

12. **Lexington, Ky. 38° 6′ N., 84° 18′ W. (From our correspondent, Prof. Robert Peter.)**

	Bar.	Bar.	Bar.	Ther.			
March 16th,	29.02	28.97	29.00	45°	41°	36°	Rain, sleet, wind very high in the night NW.
17th,	28.86	29.00	29.02	30	34	36	Snow, windy, N. winds at night.

	Bar.	Bar.	Bar.	Therm.			
18th,	29.01	29.02	29.02	36	50	40	Clear, more clear.
19th,	28.98	28.88	28.85	40	65	57	Hazy, clear.

Rain 0.05 on night of the 15th.
" 0.40 on " 16th.
" 0.10 on " 17th.

Whole amount, 0.55 of an inch.

The wind, if my recollection serves me, was at its height on the night of the 16th, NW., and was still high on the 17th, N.

13. Wilmington, O. (a little north from Cincinnati,) 39° 30′ N., 84° 53′ W. (From A. Jones, M. D., by Hon. P. G. Goode.)

It commenced raining at noon on the 13th of March, and continued rainy until noon of the 16th, at which time it snowed and rained alternately. But a small quantity of rain fell. On the 17th, snow from a half to one inch deep. The wind on the 16th, 17th, 18th and 19th, was NW., and a good part of the time a strong current. On the 17th and 18th, very strong current NW.W. The morning of the 18th was clear, and continued so till the 23d, at night, when there was a slight rain.

Troy, O., (80 or 90 miles N. of Cincinnati.) (From John G. Talford, Esq.)

On the night of the 16th of March, and also on the night of the 17th, we had a slight fall of rain and snow, (mixed.) The 18th was a clear, warm, and pleasant day, and I find noted, the honey bee out this day for the first time. On the 16th the wind was NW., not strong; and on the 17th and 18th it was N., gentle. The thermometer ranged from 26° to 70°.

14. Springfield, O., 39° 30′ N., 84° 50′ W. (From our regular correspondent, M. G. Williams, Esq.)

Began to rain at 6½ A. M. of the 16th March, changed to snow at 9, and terminated at night, 0.23 inch of water. Wind all day at N. 2, clouds NNW. 2. On the 15th the wind was NW. 3–2 all day, and on the 17th it was NW. 3 at 7 A. M., and at 2 P. M., NNW. 4; clouds N. 2, and at sunset NNW. 3; cloudy all day. 18th, clear; wind all day NNW. 2–3–1. The barometer was, on the 15th, 28.95, and fell to 28.86 on the morning of the 17th, at which it stood all day, and rose again on the 18th to 28.90, but fell very rapidly on that day to 28.63.

15. Greenfield, Ind., (near the middle of the state,) 39° 53′ N., 85° 52′ W. (From our regular correspondent, David Alter, Esq.)

March 15th, cloudy; light breeze from NW. and occasionally a sprinkle of rain. 16th, breeze from the N. and some snow falling. 17th, clear, strong wind from N. 18th, clear, light breeze from N.

Rome, Ind., 37° 58′ N. 86° 32′ W. (60 miles SW. of Louisville.) (From Samuel Frisbie, Esq.)

We had no storm of rain or snow during the days named. Indeed, previous to the 6th of April, we had no rain for a long time, and the Ohio bottoms became very dry and hard to plough. I must say, however, I took no note of the weather, and I rely solely on my recollection.

16. Washington, Michigan. (From D. Cooley, Esq., P. M.)

March 15th, cloudy. 16th, snowed moderately through the day; amount

of snow two inches; wind brisk from NE.; clear at 9, P. M. 17th, 18th and 19th, clear; wind not noted.

Centreville, Michigan, (Southern part of the state, and nearer the west than the east.) (Observed by Wm. Connor, Esq., communicated by J. W. Lawley.)

March 16th, at 4½, A. M., commenced snowing, heavy wind NW.—cold —at noon stopped snowing; depth of snow two inches. The 17th, clear and pleasant; snow gone at noon. 18th, clear and warm. 19th, thermometer 66° in the shade.

17. Western Reserve College, Hudson, O., (NE. corner.) (From our correspondent, Prof. Elias Loomis.)

March 15th, dense drizzling fog, wind faint from NW. 16th, wind light from NW. to NNW., with some snow and drizzling. 17th, wind fresh in the morning, strong in the afternoon from N., varying from about NNW. to NE., (March wind.) 18th, perfectly clear and bright; wind light from NNW. to N. The barometer was nearly stationary on the 16th and 17th, at about 28.86; on the 18th it fell to 28.79, and on the 19th to 28.47.

18. Jefferson, N. C., (Northwest corner of the state,) 36° 30′ N., 81° 20′ W. (From R. Murchison, Esq.)

The storm commenced here some time in the night of the 15th of March, with rain strongly driven by W. and NW. winds, and terminated on the 18th in the afternoon. The wind blew with little variation from W. and NW. much of the time with great velocity.

There was considerable rain on the night of the 15th and on the morning of the 16th; and about noon on that day a furious storm of snow commenced that continued till about (or a little before) 12, M., on the 18th. The whole of the 17th was the most constant and violent snow storm I ever saw to continue so long.

It is difficult to state the precise depth of the snow. I presume it would have averaged say 18 or 19 inches deep, if the wind had not blown so as to drift it.

It was very cold during the storm; range of mercury, from 25 to 8 above zero.

19. Charleston, S. C., 32° 47′ N., 79° 57′ W. (From our correspondent, Ed. C. Kecksley, M. D.)

March 16th, wind south—rain.
17th, wind south—cloudy.
18th, wind NW.—fair.
19th, wind NW.—fair.

The rain of the 16th was very trifling. Since then to this time, (3d of April,) we have had no rain. During the whole of the month of March we have had very little wind; indeed, the atmosphere has been close and sultry.

20. Newbern, N. C. 35° 20′ N. 77° 5′ W. (From Wm. G. Bryan.)

Clear, and pleasant, and calm, on the morning of the 16th. Light wind in the afternoon at south. On the 17th, cloudy and warm. Light rain before day, wind at south. Afternoon cold and cloudy—rain and hail—wind west. On the 18th, cold and cloudy, moderate wind at NW. The 19th

was clear and cold, moderate wind W. 20th, very pleasant—smoky—wind SW.

21. New Garden, N. C., (eight miles NE. of James Town,) 34° 57′ N., 79° 10′ W. (From Jona. L. Slocum, communicated by David Lindsay, Esq.)

On the 16th the weather was cloudy and damp during the day, in the evening some thunder and rain; wind NE. all day. On the 17th, cloudy in the morning, and in the afternoon and evening rain falling, mixed with snow; wind NE. On the 18th, wind NW. till evening, then NE.—cloudy—snow nearly two inches deep. 19th, wind NW. all day, clear and pleasant.

Smithville, N. C., (SE. corner of the state,) 34° 7′ N., 78° 10′ W. (From G. S. Jewett, Esq.)

March 16th, clear and fine; wind SW. probably light. 17th, clear, cold and windy, WSW. 18th, cold, a little rain, windy, NW. Also, 20 miles above Smithville, March 16th, pleasant day; wind SW., very fresh about 1, P. M. 17th, wind not high this day. 18th, not known. 19th, wind NW., pleasant.

22. Alexandria, D. C., 38° 49′ N., 77° 4′ W. (From our correspondent, Wm. E. Harper, Esq.)

The storm commenced on the 16th, and terminated on the evening of the 18th.

The wind blew constantly from the NE. strong on the 16th, 17th and 18th, and there was considerable rain, snow, and hail on the 17th, continuing till noon of the 18th.

On the 19th, wind strong from NW. The thermometer at freezing point before sunrise.

23. Capitol Hill, Washington City, 38° 53′ N., 77° 2′ W. (From our correspondent, Dr. J. M. Foltz, of U. S. Navy.)

The wind on the 16th of March was SE., and light; On the 17th, a strong gale from NE. On the 18th, NE., fresh, and on the 19th, NW., moderate.

At 9 o'clock, on the 17th, it was raining, and had rained $1\frac{1}{100}$ inch; it rained and snowed two inches on the 17th and on the 18th, $\frac{8}{10}$ inch more; making in all 3.81 inches. The barometer was stationary on the 16th at 29.93. It fell by 9 A. M. of the 17th, to 29.758, and at 3 P. M. it was down to 29.60, and was the same next morning.

Dr. Foltz infers, from the great severity of the storm, and from the quantity of rain and snow accompanied with a strong NE. gale, that he was, at Washington, in the centre of the storm.

24. St. John's College, Annapolis, Md., 20° 0′ N., 76° 43′ W. (From our regular correspondent, Prest. H. Humphrey.)

The storm was of great violence, and as far as I know blew steadily from the NE. When I rose on the morning of the 17th of March, it was raining moderately, and I observed the Barometer had fallen from 30.00 to 29.76. It continued to sink all day, and at 6, P. M., was 29.62, and on the morning of the 18th, at 7, was 29.59.

My opinion is, that the wind began to blow about 11, P. M. of the 16th,

at which time I observed a remarkable light, due E., that I took to be an aurora. I watched it for some time after my lamp was extinguished, and it exhibited vivid pencils, as high as 45° or 50°, and cast a strong light, although obstructed by broken clouds. It was soon after this that I noticed the raising of the wind, by its effect on the building. The rain on the 17th turned to snow in the afternoon, which continued through some part, or all of the night, but the quantity was small, leaving but two or three inches on Sunday at noon. The rain fell in torrents, and the gale blew at times as powerfully as I have ever felt it at this place. Its violence abated somewhat on Sunday afternoon.

25. **Gettysburg, Penn., (south side of the state.) (From our regular correspondent, Jacob Lefever, Esq.)**

The storm commenced with dribbling of rain at 10½, P. M., March 16th, and the heavy fall of snow terminated about 9½, A. M., on the 18th, although there were frequent showers of fine snow till about 5½, P. M. The morning of the 19th was very nearly clear and calm. The wind was NNE., that is, nearer N. than NE. all the time. It commenced with rain; but on the morning of the 17th, the snow was ¾ inch deep, and melting very fast. The whole quantity fallen I calculated at 1.7473 inches. The snow along the mountain, within ten miles of this place, was said to have been at least 2½ feet deep.

The wind was from 2 to 3 from the evening of the 16th till the evening of the 18th. That is, a strong breeze.

26. **Bellefonte, Penn., (near the centre of the state,) 40° 54′ N., 77° 47′ W. (From our regular correspondent, John Harris, M. D.)**

The snow commenced at 10, P. M., of the 16th, and continued till 4, P. M., of the 18th, being a great part of the time mixed with rain; its depth about 7 inches—whole quantity estimated at 1.5 inches of water.

The wind was N. at 7 A. M. of the 16th and gentle; from 2, P. M., of the 16th, till 7, A. M., of the 19th, the wind was constantly very gentle from NE., when it changed to SW. Barometer all day of the 16th, 29.29; at 7, A. M., of the 17th, 29.25; at 2, P. M., 29.24; at 9, P. M., 29.20.

27. **Meadville, Penn., 41° 38′ N., 80° 10′ W. (From our regular correspondent, Frederick Huidekoper.)**

	Thermometer.			Barometer.			Direction & force of wind.		
Day.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.
March 16	33°	36½°	29°	$\overset{0}{28.85}$	$\overset{0}{28.87}$	$\overset{0}{28.85}$	N. 1	N. 2	N. 4
17,	29	34	33	$\overset{0}{28.83}$	$\overset{0}{28.83}$	$\overset{0}{28.84}$	ENE. 4	E. 5	E. 3
18,	27	45	27	$\overset{10}{28.82}$	$\overset{10}{28.81}$	$\overset{10}{28.77}$	ENE. 4	ENE. 5	0

On the 16th, snow too slight to be measured.

28. **Rochester, N. Y., 43° 8′ N., 77° 51′ W. (From John B. Elwood, Esq.)**

	10 o'clock, A. M.				10 o'clock, P. M.			
	Ther.	Bar.	Wind.	Sky.	Ther.	Bar.	Wind.	Sky.
March 15th,	48°	29.60	S.	Cloudy.	40°	29.60	W.	Cloudy.
16th,	37	—.70	NE.	do.	32	—.75	NE.	do.
17th,	36	—.80	E.	Fair.	37	—.75	E.	Fair.
18th,	43	—.65	E.	do.	34	—.50	NE.	do.
19th,	35	—.30	W.	do.	43	—.35	E.	Cloudy.
20th,	32	—.30	NW.	Cloudy.	38	—.60	NE.	do.
21st,	34	—.70	NW.	Showers.	50	—.60	SW.	Showers.

The winds were at no time very strong, or a note would have been made of it.

29. **Onondaga Hollow, N. Y., (middle of the State,) 43° 0′ N., 76° 6′ W., nearly. (From J. L. Hendrick, Esq.)**

We had no storm here except a small snow storm on the afternoon and evening of the 16th of March; the wind NW. all day. On the 17th, the wind somewhat variable, generally N., (A. M.) and N., NNE. and NE., (P. M.;) cloudy all day. On the 18th, wind N. and NNW. (A. M.) and NW (P. M.;) day cloudy. On the 19th, wind variable, but generally W.; day fair. The strength of the wind during those days was also variable; sometimes, and especially from the W. and NW., rather strong, at other times only a gentle breeze.

30. **Silver Lake, Penn., 41° 55′ N., 76° W. (From our regular correspondent, a lady.)**

	Thermometer.			Barometer.			Winds.		
Day.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.
March 16,	36°	38°	36°	$\frac{0}{28.00}$	$\frac{0}{27.98}$	$\frac{0}{27.98}$	SSE.2	S3.	S2.
17,	32	38	34	$\frac{0}{28.00}$	$\frac{0}{28.00}$	$\frac{0}{28.00}$	NW.2	NW.2	NNW.2
18,	31	42	58	$\frac{10}{28.00}$	$\frac{10}{28.00}$	$\frac{10}{28.00}$	NW.1	NW.2	NW.3

On the night of the 16th it snowed one inch deep, and on the 17th, it snowed half an inch.

31. **Sunbury, Penn., 40° 53′ N., 79° 50′ W. (From our regular correspondent, Hugh Bellas, Esq.)**

	Thermometer.			Barometer.		
	8 A.M.	Noon.	5 P.M.	8 A.M.	Noon.	5 P.M.
March 16th,	41°	49°		29.45	29.45	
17th,	34	37	36°	29.45	29.45	29.45
18th,	32	38	36	29.30	29.30	29.30

On the night of the 16th snow six inches deep; on the mountains between this and Pottsville, three or four feet deep—no mails for seven days.

Snow, rain and snow, on the 17th, and on the morning of the 18th, the wind NE., on the 16th, 17th, and 18th, except at 8 A. M. of the 17th, when it was E. On the 19th changeable from NW. to SW.

32. **Bucks County Academy, Penn., 40° 17′ N., 75° 7′ W., nearly. (From our regular correspondent, Prof. L. H. Parsons.)**

	Thermometer.			Barometer.			Winds.		
	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.	7 A.M.	2 P.M.	9 P.M.
March 16th,	44°	56°	43°	$\frac{29.92}{1}$	$\frac{29.82}{2}$	$\frac{29.81}{0}$	NE.½	NE.½	NE.½
17th,	37	35	33	$\frac{29.87}{0}$	$\frac{29.81}{0}$	$\frac{29.73}{0}$	NE.½	NE.2	NE.3
18th,	32½	34½	33	$\frac{29.60}{0}$	$\frac{29.65}{0}$	$\frac{29.65}{0}$	NE.2½	NE.1	NE.1

It rained on the night of the 16th; depth of snow, 5 inches in all; ceased on the night of the 17th. Snow and rain, 2.48 inch water.

33. **Reading, Penn., 40° 18′ N., 75° 55′ W. (Observed by C. F. Egelmann, Esq., communicated by Saml. Ritter, Esq.)**

March 16th, cloudy, with NW. wind at 2, P. M. Temp. 62°. 17th,

rain at 7, A. M., turning to snow at 7½; snow continued, with occasional rain, till the morning of the 18th, wind strong from NE. all the time; in the evening it changed round to NW., and was NW. and W. next day. On the 17th, the thermometer was from 34° to 33° all day.

34. Philadelphia, Penn., 39° 57′ N., 71° 11′ W. (By James P. Espy, Meteorologist of Joint Committee.)

March 16th, wind very gentle N., and clouds from SW. 1, and cloudy at 7, A. M.; wind got round to NE. 1 before 2, P. M., clouds still coming from SW. 2; a slight sprinkle of rain at 9, P. M.

17th. On the morning of the 17th, at 7, it began to rain, mingled with hail; it rained much during the morning, and snowed much in the afternoon, wind and clouds from NE.; storm increasing in violence all day, and continued very violent all night, until 9, A. M., of the 18th, when it began to abate, and at 1, P. M., it had nearly ceased snowing; wind still very strong N. E. A little snow in the afternoon, and by 6, P. M., the wind had veered round to N. by E., and gradually died away in the night; and on the morning of the 19th it was, with the lower clouds, N., very gentle, and the upper clouds from the west, moving quite slow.

The barometer was stationary on the 16th, at 29.91, and fell on the 17th, from 29.93, at 7, A. M., to 29.78, at 9, P. M., and was at its lowest, 29.68, on the next morning. The thermometer ranged from 44° to 55° on the 16th; from 37° to 33° on the 17th, and was only 33° at 2, P. M. The dew point was 38°, or 17 degrees below the temperature of the air on the 16th, at 2, P. M.; and at 2, P. M. of the 17th, it was almost the same as the temperature of the air itself, or 33°.

Greendale, Penn., (west of the centre of the state.) (From our regular correspondent, H. B. Wright, Esq.)

March 16th, calm, clouds from N., small rain P. M., cloudy all day. 17th, calm till 11, A. M.; snow all day and all night till 9, A. M., of the 18th; clearing at 6, P. M., with fog in the night.

Wind NE. on the 17th; calm again on the 18th; warm on the 20th, with high waters. Whole quantity of water deposited, 68.100.

35. Snow Hill, Md., (Eastern Shore, southern part,) 38° 10′ N., 75° 25′ W.

On the morning of the 16th, appearances of rain; at 4, P. M., raining, wind nearly calm, NE. On the 17th, at 8, A. M., rain—wind ENE. 4; it rained all day, wind NE. 5, and continued to blow hard all night, frequently raining hard. Towards day on the 18th, it became moderate, and at 11, A. M., wind was N. 4, still cloudy and dark; at 5½, wind N. 4, rain, mixed with snow. On the 19th, in the morning, the wind was west, and moderate; at 4, P. M., it was northerly and clear.

36. Log Book of ship Algonquin, near Delaware Capes.

March 16th, noon, civil reckoning,—Light airs from WSW., and clear; at 1, P. M., calm; at 6, P. M., light airs from E.; sounded in 50 fathoms water; midnight, strong breezes from E. by N., and hazy; at 4, A. M., strong breezes and rain; 35 fathoms water; at 5 took in top gallant sail; double reefed the mizen top sail; at 7 double reefed the fore and mizen top sail, took in the jib; at 8, strong gales, and thick rainy weather; 18 fathoms water; wore ship's head to SE., [to avoid coming on shore;] at 11, A.

M., gale ENE., increasing; moderately strong, and a high sea; raining very heavy; sounded 22 fathoms water; continuing with strong gales NE. by E.; heavy squalls and torrents of rain; bearing a heavy press of canvass to get off shore; at 4, P. M., took in main sail; 23 fathoms water; at 6, P. M., 30 fathoms water; took in fore topsail; *at* 10 *minutes past* 6, *fell start calm;* left a very heavy sea; midnight *calm;* cleared off; very heavy swell; at 2, A. M. of 18th, light air from south, set the fore sail and fore top sail; shut in thick; at 4, A. M., light airs and thick weather; at 5, A. M., set single reefed top sails, jib, and spanker main sail, wind still south; at 8, set the top gallant sails; thick weather; noon, moderate breezes, wind baffling.

Batavia, N. Y., (near NW. Corner of the state,) 42° 58′ N., 76° 20′ W., nearly. (From W. H. Webster, Esq.)

Wind on the 16th, 17th and 18th of March, fine acicular crystals of snow falling all day of the 16th, but now lying on the ground. Sun seen through the clouds all day on the 17th.

37. Catskill, N. Y., 42° 10′ N., 73° 52′ W. (From the Postmaster.)

Between the 16th and 19th of March, about 3 inches of snow fell; wind southerly at first, soon veering about SE., N. and NW.; a heavy gale on the 18th and 19th, wind northerly.

38. Pottsdam, N. Y., 44° 38′ N., 74° 59′ W. (From David S. Shelden, communicated by H. Allen, Esq., P. M.)

March 16th, wind all day N., with a little snow in the morning. On the 17th, cloudy in the morning, clear in the afternoon; wind all day NE., light. On the 19th, clear in the morning, a little rain in the afternoon; wind NE. in the forenoon, and SW. in the afternoon, very light.

39. Montreal, Canada, 45° 31′ N. 73° 35′ W.

From the Journal of James McCord, Esq. it appears that it neither rained nor snowed here during 16th, 17th, 18th, 19th or 20th of March, and the wind blew steadily, but not violently, from the North, on the 16th, 17th, 18th and 19th, and on the 20th shifted to the N. W.

The Barometer stood as follows:

16th,	morning,	30.040	evening	30.124
17th	"	30.250	"	30.200
18th	"	30.088	"	29.890
19th	"	29.678	"	29.464
20th	"	29.724	"	29.750

The mean of the maximum and minimum of the thermometer, during those days was 31° and 8°.

The mornings were generally clear and fine, growing cloudy towards the evening. The strength of the wind may be called a *fresh breeze.*

40. University of Vermont, Burlington, 44° 30′ N., 73° 12′ W. (From Prof. Geo. W. Benedict.)

There was no storm here of any kind during the days in question. The whole month of March, previous to that time, was remarkable here for its mild and quiet character. East winds are almost never known here.

Though I made no record of the wind on the days mentioned in the circular, I am confident that the set of the air (quite slight) was from the south, and the weather pleasant.

41. Charlestown N. H. 43° 14′ N. 72° 25′ W. Dr. S. Webber.

March 16th, wind N. E. cloudy, broke away partially for a little while about noon shewing many broad streaks of cirro-strati—in the afternoon, sky again overcast looking like rain, Therm. 34°.

17th, wind N. E., cloudy through the day—at noon wind became E. but changed again to N. E., Therm. 36°.

18th, wind N. E. fresh and raw, about 11 A. M. began to snow which continued moderately through the day, Therm. 29°.

42. Jafrey, N. H., S. W. corner of the State, 42° 45′ N. 72° 5′ W.

L. Howe, Esq. informs us that there was no storm there—only one inch of snow on the 18th, at noon, fair on the 19th. On the 16th and 17th, wind not recollected.

43. Wesleyan University, Middletown, Con., 41° 34′ N., 72° 39′ W. (From our regular correspondent, Prof. Aug. W. Smith.)

On the morning of the 16th, at 7½, A. M., the wind was noted NW., the rest of the day N., quite gentle. On the 17th, wind N. at 7½, A. M.; and clouds NE.; at 12, meredian, and 5½, P. M., wind E., and gentle all day; cloudy, with slight rain at 2, P. M. On the 18th, snow about two inches deep all the morning; time of beginning not mentioned; wind NE. all day, and strong. 19th, wind NE., A. M., strong, and NW., P. M., gentle. Barometer rose from 29.81 on the morning of the 16th, to 30.11, at 5½, P. M., of the 17th; fell again till 5½, P. M., of the 19th, when it was 29.70.

44. Newport, R. I., 41° 28′ N., 71° 21′ W. (From our regular correspondent, R. J. Taylor, Esq.)

March 16th, wind from NW. in the morning, and SW. P. M. 17th and 18th, and morning of 19th, NE.; then NW. at 2, P. M., and SW. at 9, P. M.—*heavy on the 17th.*

	7 A. M.	2 P. M.	9 P. M.
March 16th, Barometer	29·65 / 10	29·72 / 10	29·80 / 0
17th, "	29·90 / 0	29·90 / 0	29·86 / 0
18th, "	29·67 / Snow.	29 57 / 0	29 51 / 0

Snow from 6 to 12 inches on the 18th.

45. Brown University, Providence, R. I., 41° 50′ N., 71° 25′ W. (From our regular correspondent, Prof. Alexis Caswell.)

	Barometer.			Thermometer.		
	S. R.	1 P. M.	10 P. M.	S. R.	1 P. M.	10 P. M.
March 17th,	29.90	29.96	29.91	35°	38°	34°
18th,	—.74	—.70	—.60	31	32	28
19th,	—.74	—.45	—.41	28	38	34

		Winds.			Weather.		
	S. R.	1 P. M.	10 P. M.	S. R.	1 P. M.	10 P. M.
March 17th,	NE.	NE.	NE.	var.	cloudy.	cloudy.
18th	"	"	"	snow.	snow.	snow.
19th,	"	easterly.	easterly.	cloudy.	cloudy.	clear.

The 15th was mild and pleasant—16th do. and wind came to NE. A. M.; on 17th wind NE. brisk and raw, increasing towards night and cloudy. Wind heavy during the night.

On the 18th snow began to fall about 6 A. M., wind heavy NE., snow continued till after 10 P. M. but ceased before morning. The wind was so violent during the storm, that the snow was considerably drifted; quantity half an inch water.

46. Dedham, Mass., 42° 15′ N., 71° 11′ W. (Journal of Mr. Talbot, communicated by Elisha Thayer, Esq.)

16th, fair, moderate NE. wind.
17th, cloudy, strong NE. wind.
18th, cloudy, very strong NE. wind, with 2½ inches snow.
19th, cloudy, moderate NW. wind.

47. New Bedford, Mass., 41° 37½′ N., 70° 56′ W. (From Richard Williams, Esq.)

		Ther.	Bar.	Wind.	Weather.
March 16th,	sunrise,	37°	30 00	NW. light.	clear.
	2 P. M.	49	30.09	NE. mod.	clear.
	9 P. M.	41	30.18	" "	cloudy.
17th,	sunrise,	37	30.23	" fresh.	"
	2 P. M.	40	30.29	" "	"
	9 P. M.	35	30.26	" high.	"
18th,	sunrise,	34	30.11	" "	beginning to snow.
	2 P. M.	33	29.99	" "	snowing lightly.
	9 P. M.	33	29.91	" fresh.	cloudy, water fallen .60.
19th,	sunrise,	32	29.78	NNE. "	light snow.
	2 P. M.	36	29.71	N. mod.	clouds broken, P. M. [clear.
	9 P. M.	32	29.74	westerly, light.	clear.

Northboro, Mass., 42° 16′ N., 71° 48′ W., nearly. (From Joseph Allen, Esq.)

March 16th. This was a mild, pleasant day, wind SW.; some time during the night the wind shifted into the NE.; and the 17th was raw, cold, and cloudy—wind pretty strong from NE. Early on the 18th, the snow began to fall, and the wind to rise; and through the day the storm continued without intermission, though its violence abated somewhat in the latter part of the afternoon. The snow was quite moist, yet so great was the violence of the wind, that it drifted a good deal, probably about six inches in depth.

Williams College, Mass., (NW. corner of the state,) 42° 30′ N., 73° 12′ W.

President Albert Hopkins states that from the 16th to the afternoon of the 17th, the wind was NW., and then changed to NE.; that it commenced snowing soon after breakfast on the morning of the 18th., wind N., or perhaps a little E. of N. On the 19th, it was from N. to NW., and clear. The thermometer varied only from 30.5° to 39° till the 19th, when it rose to 43°, wind very light.

48. Concord, N. H., 43° 12′ N. 71° 29′ W. From John Farmer, Esq.

The storm was hardly felt here. The weather was cloudy all day, on the 17th of March with the wind E. and N. E. On the 18th a light snow commenced at noon, and continued through the afternoon, enough to cover the ground.

The wind was brisk part of the day, from the N. E. The highest point of temperature during the day was 33° and the lowest 28°.

On the 19th at 9 A. M., all appearances of a storm had ceased, wind N. W. as it had been on the 16th.

The Thermometer stood as follows:—

	6 A. M.	Highest	9 P. M.
16th	33°	54°	43°
17th	36°	43°	35°
18th	33°	33°	28°
19th	28°	50°	38°

49. Bethlehem, N. H. 44° 20′ N. 71° 35′ W.

William Kenney, Esq. informs us that there was no storm here, the weather was mild and pleasant till the afternoon of the 18th, when there was a very little snow—the wind was very little, westwardly.

50. Portland, Maine, 43° 39′ N. 70° 20′ W. From the Diary of Lemuel Moody, Esq.

March 16th from morning to noon, light N. E. airs and clear weather. P. M. clear, calm, warm and pleasant. Thermometer at sunrise, 34° noon 46°, 8 P. M. 40°.

17th, from sunrise to noon, clear weather, with light N. E. airs. P. M. cloudy with light S. E. airs, inclining to calm.

Therm. 30° 38° 32°.

18th, forenoon brisk wind, varying from E. N. E. to N. E., with thick cloudy weather, particularly so in the south quarter. At half past one, commenced a moderate N. E. snow storm, wind not more than a brisk gale. Snow fell very moderately and ceased the first part of the evening, snow 1½ inches deep.

Therm. 30° 30° 26°

19th, forenoon moderate N. E. winds and cloudy. P. M. light winds from E, round to S. Evening clear, calm and pleasant.

Therm. 28° 45° 38°

The foregoing furnishes a summary of the information received concerning the storm, both from our regular correspondents, and in answer to the circular issued by the joint committee.

The following facts, chiefly collected from the newspapers of the day, will be found highly interesting in connexion with those already given.

From the American Sentinel, March 23.

Arrived at Philadelphia, March 23d, packet ship Algonquin, having been 11 days to the north of Cape Hatteras. On the 17th, at 8, A. M., Cape Henlopen bearing NW., distant 15 miles, took a heavy gale E. by N.; hauled off. On Sunday, the 18th, latitude 37° 50′, spoke brig Venus, for New York, who had lost two men and jib boom by gale on day previous.

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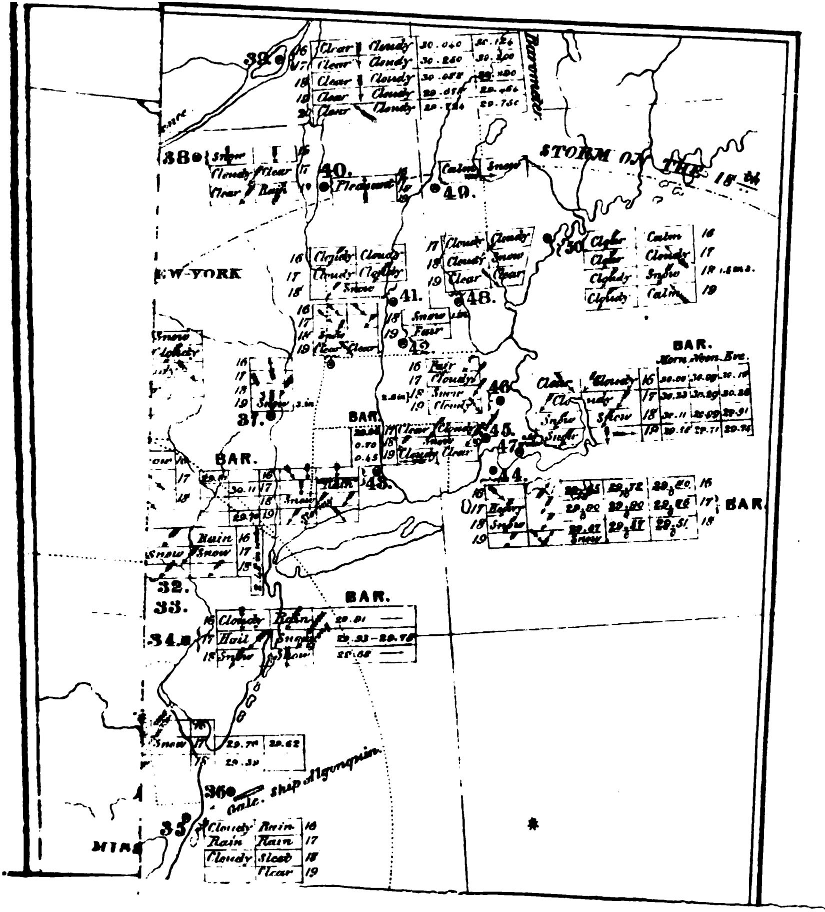
From the Baltimore American of the 20th.

now on the 17th and 18th, was deeper to the west than at



anical skill displayed in the adju... ss
which have been the subject of patents, and on this
. As a surgical instrument, it does not possess any

novelty. The end of the spring which sustains the pad, is made square, and passes through a square hole in a piece of brass which forms a part of the adjustment of the pad, which can be slipped off, and reversed, and thus adapted to either groin. This, it is true, is of no great consequence, as the disease itself is not of a shifting character, and trusses are not left as heir looms; there, however, is nothing objectionable in this part. The said piece of brass carries a ratchet adjustment to alter the slope of the pad, as in many others. The back plate of the pad is of metal, in the centre of which there is a hole through which the stuffing of the pad may be regulated; a metal lid, or button, covers this hole. The pad swivels to the necessary distance so that it can receive an inclination to the right, or left, and be fastened by a screw. There are six claims made to individual parts, some of them of doubtful originality.

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346. For a *Machine for Shaving Shingles;* Aaron H. Akin, Sparta, Crawford County, Pennsylvania, November 4.

The shingle to be shaved is placed upon a bench by an attendant, and a knife, fixed in a sliding frame, is drawn over it by the action of a crank and pitman; there are contrivances operating as a stop to the shingle as the knife passes over it, and for relieving it at the proper time. The claim is in general terms, and the construction and operation of the machine are not very clearly described, although they might be made out by some special study.

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347. For an improved mode of constructing the *Gauges in Machines for sawing Shingles*; Akanah Leonard, Canton, Oxford county, Maine, November 4.

The gauges referred to are those for cutting the block to be sawed, and the claim made to them in their improved form is to "the mode of changing the attachment between the gauges and the sliding block at a greater or less distance from the centre of the latter, and the method of attaching them as described;" the particular arrangement for doing which would require the drawing for its explanation.

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348. For an improvement in *Stoves;* Henry H. Roath, Norwich, Connecticut, November 4.

There is some peculiarity in this stove, which is one of the vertical cylinder kind, and intended for heating only; the peculiarity consists in the manner of arranging certain tubes and chambers for the passage of heated air, and certain openings for its escape. The claims made are confined to these particular matters of construction, which do not appear to demand any special notice.

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349. For an improved *Cooking and Warming Stove;* John Morris, Derby, New Haven county, Connecticut, November 4.

This is an open stove, or rather a combination of open stoves, intended for warming parlors, or to be used for cooking. The front of the grate is in the form of a segment of a circle, about three feet long, and divided into three compartments, appearing like three open grates placed side by side. These project out from the fire place, and are covered by a flat plate extending over the whole of them. In this plate there are three

openings for cooking utensils, and others for feeding the fire. The three compartments are to be used conjointly, or separately, and the draft from them all unites in one common flue, or discharge pipe, valves being employed to govern their action. Above, and behind, the fire places, there is an oven surrounded by flues, through which the heated air may be made to pass back and forth before it reaches the chimney. Certain modifications of its respective parts are described, and a claim made to the manner of combining them, as set forth.

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350. For a *Machine for Moulding and Pressing Brick;* Henry Waterman, Bath, Lincoln county, Maine, November 4.

In this machine the clay is to be put into a mixing tub, or pug mill, in which it is acted upon by knives so beviled as to act as conveyors to force it downwards, and to cause it to pass through two openings on opposite sides of the tub, into two chambers, or boxes, the bottoms of which are formed of open divisions corresponding with brick moulds which are to be passed in below the chamber. A piston, forming the top of the chamber, is depressed by suitable machinery to force the clay into the moulds. The particular arrangement for moving the respective parts we shall not attempt to describe, but they of necessity form the subject matter of the claims, as the general construction is without novelty.

Claim. "The invention claimed by me, and which I desire to secure by Letters Patent, consists in, *first*, the method of moving the piston by means of the cams and frames as before described. *Second*, the method of moving the carriage by the arrangement of the arms attached to, and moved by one of the cams, as described. *Third*, the construction of the conveyors for conveying the clay from the mixing tub, through the apertures at the bottom thereof, into the chambers, in combination with the other parts of the machine, as described. *Fourth*, the second method of moving the piston by the crank, or hook. *Fifth*, the method of regulating the pressure of the piston by the nuts on the ends of the vertical rods."

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351. For an improvement in *Stoves, Grates, Boilers and Ovens;* Caleb Stade, city of Troy, New York, November 11.

The following claim if not distinguished by depth, is certainly not deficient in length. As we have observed on more than one occasion, but little of actual novelty is to be looked for in stoves. Perhaps when some new kind of fuel is pressed into the service, which shall differ as much from the kinds now in use, as does anthracite from bituminous coal, and from wood, we may actually see stoves differing in species from those now employed, but until then it will be best to expect varieties only, artificially produced by the crossing of breeds. But to the claim. "What I claim, is the manner of constructing the air chamber between the flanch which supports the grate and furnace, and the external plates of the stove, in combination with the air chamber next above it, in the manner, and for the purposes described. The manner of constructing the platforms, and of attaching them to the stoves, and supporting them in that combination, and detaching them from it, in combination also with the air chamber, in the manner and for the purposes described. The manner of constructing the boilers, with the manner of applying the hot air from the air chamber to, and in heating both, in combination with each other, and with the stove of the

above description. And also the double oven in combination with the same stove, and for the uses and purposes described."

Some of the things above claimed we could readily describe, but we do not wish to give the requisite time and space. Some of the others it might puzzle us to pourtray in words, and if described it might also puzzle our readers to discover their importance; we therefore forbear; a thing we are the more willing to do as fashion, which in every thing bears sovereign sway, has its capriciousness fully exemplified in stoves; the ornaments of ladies heads are scarcely more changeable. We have every winter *ne plus ultra* stoves, and the next winter we go far beyond them.

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352. For a *Machine for Cutting and Dressing Granite and other Stone;* Wm. C. Poland, and Earl Blossom, Portland, Cumberland county, Maine, November 11.

This machine, we are told, consists essentially of four parts, "1st. a gang or set, or sets, of drills, to aid in reducing the face of the stone to an even surface. 2nd. A set, for breaking the pieces left between the holes made by the drills. 3rd. A gang of cutters to do the work usually done by chisels. 4th. A gang of finishers."

The drills operate much like those used for hand drilling, in blasting rock, but their shafts are to be lifted by cams, and they are to be gauged so as to enter the stone to a given depth; provision is made to cause them to turn to a certain distance between each stroke. Rows of holes are thus to be successively made. When this is completed, the set which is to cut away the portion between the holes, is made to operate in a curved direction, something like a cooper's adze. The other instruments are afterwards made to pass over the surface thus prepared, for the purpose of finishing. The claims are to "the combination and arrangement of the drills, set, cutters, and finishers, in the manner described. The form of the set, extending quite across the face of the stone to be dressed, in combination with the other parts of the machine. The method of vibrating the drills as described."

Since the publication of the account of the successful operation of Hunter's patent stone planing machine, in Scotland, a number of similar machines have been made the subject of patents with us, but hitherto we have not received any anthentic history of their successful operation. The reason, we apprehend, is the intrinsic difficulty of causing such machines to operate well upon stone of the texture of good granite. Such stones have been actually dressed by the machines, but we apprehend that the difficulty of keeping the cutters in order has been found to be very formidable, and that it will so continue.

We have, in more than one instance, been assured that we should see the machines in use at the public buildings in Washington, but are still in waiting. We are using, as well as some granite, much miserable sand stone, which they might cut, although they would occasionally meet with a pebble that might require more humouring than would comport with the steady progress of a machine; our granite, we fear, will still bid them defiance, in which case the walls of our public buildings may continue to be built, as they have heretofore of *filtering stones.*

353. For an improvement on his *Machine for Cutting Meat;* patented February 25th, 1835. John Morris, Derby, Connecticut, November 11.

Those interested may see our notice of the original machine at page 170, vol. xvi. The improvements claimed are "the scraper, as specified. The alteration in the machine whereby the cutting is performed by a single horizontal knife, aided by the scraper; by which a multiplicity of knives are dispensed with, all clogging avoided, and the machine rendered more simple, &c."

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354. For a machine for *Separating Garlic from Grain;* Henry Staub, Sheperdstown, Jefferson county, Virginia, November 11. (See Specification.)

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355. For an improvement in the construction of *Locks for Fire Arms*; Ethan Allen, Grafton, Worcester county, Massachusetts, November 11.

The claims made are to the trigger, which is not only to discharge, but also to cock the piece ready for a new charge. To the dog or catch, which can be thrown out of action when not wanted, and leave the tumbler free to the action of the main spring; the tumbler is claimed as of an entirely new construction. The particulars of these novelties are shown in the drawings, but it is unnecessary to dwell upon them here.

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356. For improvements in the mode of constructing *Vessels to be used as Life Preservers;* John Macintosh, city of New York, November 11. (See Specification.)

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357. For improvements in the mode ot constructing *Refrigerators;* Robert D. Burns, city of Baltimore, November 11.

This refrigerator is, we are told, "with the exception of the outer case, constructed entirely of metal; zinc, on account of its economy, and its adaptedness to the purpose, being generally employed. The metallic interior is divided into any number of compartments that may be required, the partitions being all united to the main lining of the exterior box or case, by riveting, and soldering, so that the whole shall form one continuous receptacle of metal; in consequence of the conducting property of which, the cooling of one part will rapidly influence the whole." After these preliminary remarks, the specification points out what is deemed a convenient mode of forming the divisions, and the following claim is made.

"What I claim as my invention is the forming the whole interior of my cooler of metal the continuity of which is unbroken, or rendered perfect by soldering, in the manner described, so that the cooling influence operating in one compartment, may be readily communicated to the whole by the conducting power of the metal; and this I claim in conjunction with the arrangement for retaining and drawing off the water produced by the melting of the ice, as set forth."

358. For improvements in the machine for *Cutting Shingles, Staves, Heading, and other articles;* George Park, Peterboro, Madison county, New York, November 11.

A machine of this kind is too complex for verbal description. The specification extends through ten pages, and the claims refer principally to methods of effecting the different objects in view, which, though sufficiently novel to be claimed, do not offer any thing of a striking character. The claims alone would not convey any information.

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359. For a *Machine for Cutting Staves for Barrels, &c.;* Thomas Peck, Lenox, Madison county, N. York, November 20.

The remarks made on the foregoing machine apply with equal force to this.

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360. For an improved *Combination Cooking Stove;* Jordan L. Mott, city of New York, November 11.

We shall probably obtain cuts of this stove, and publish the entire specification. The points claimed are a rotary top plate, which is double, forming an air chamber between the two; the perforations for cooking utensils being surrounded by connecting rims. There is a chamber for heated air, peculiarly constructed, and claimed, in combination with the above named double plate; and also in combination with a circular oven above the rotary plate, which oven, when not used for baking, encloses the boilers, and economizes the heat. There is an oven behind the fire, and a claim made to the dispensing with the bottom plate, in this and similar ovens, so as to admit the heated air directly into the oven itself.

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361. For an improved *Cooking Stove;* James N. Olney, city of New York, November 20. (For Specification, see vol. xx, p. 407.)

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362. For a machine for *Printing on both sides of a continuous sheet of Paper;* Thomas French, Ithaca, Tompkins county, N. York, November 20.

The machinery described in the specification of this patent is intended for printing on both sides of a continuous sheet of paper, as it comes from the couching cylinders of the paper mill. Stereotype plates are to be affixed upon the faces of cylinders, or rather of polygons, the paper passing from one such revolving polygon to another, being conducted and confined by tapes, whilst it is passing and receiving the impression. After being printed it is to pass to the drying cylinder, and thence to a cutting apparatus, or to a roller upon which it is to be wound. The manner of inking the plates, of giving the impression, of making register, &c., &c., we shall leave to be imagined, as the tale would be too long to be told here.

When an establishment is made, and carried into successful operation, we shall be most happy to collect and display all the details; should we live, however, we hope to accomplish much other work before being called to this, as we are apprehensive that the consummation will not be an early one. There is no novelty whatever in the idea of such an establishment; we have often conversed respecting it with an intelligent and enterprising paper maker, who made some attempts of the kind many years since, but relinquished the plan, not as impracticable, but as altogether ineligible. The

paper mill and the printing office must be together; the works printed must be such only as are wanted in vast numbers, and the rapidity of the printing must be governed entirely by that of the forming the sheet of paper. These are some of the objections which present themselves, and many others might be brought forward were it necessary.

The claim made is to "the combination and arrangement of the different parts of the before described machine for printing both sides of a continuous sheet of paper at one operation; whether effected in the manner set forth, or in any other substantially the same in principle."

This claim confines the patentee to an arrangement substantially the same with that described, in all its parts, but the specification does not point distinctly to any thing possessing this character. The thing in itself, as we have before remarked, is not new, and if any one wishes to apply a double cylinder press, for printing upon both sides of a sheet of paper, as it comes from the mill, there is no power any where to prevent him. The right, however, is scarcely likely to be legally contested.

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363. For improvements in the *Brick Press;* Henry Waterman, Bath, Lincoln county, Maine, November 20.

Those familiar with the modern devices in the brick press may form some idea of that above named, from the claim, which is as follows:

"The invention claimed by me consists in attaching the follower to the piston by loose rods (with heads,) which slide upwards through apertures in the pistons whilst the latter is in the act of pressing the brick on the top; and when said piston is again raised, the top of said piston coming into contact with the heads on the ends of said rods, and raising the follower suspended thereto, with the brick, which it thus discharges from the mould, at the same time said follower or discharger sliding loosely over the hanging arms by which the follower is suspended from the cross head for pressing the brick on the under side, in combination with the before described mode of pressing the upper and lower sides of the brick simultaneously, as set forth."

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364. For an improved *Cooking Stove;* Daniel Hastings, and Solomon Sykes, Deerfield, Franklin county, Kentucky, November 23.

The peculiarity in this stove consists in the manner of constructing those boiler holes which are immediately over the fire. These holes are surrounded by collars which rise up and receive the boilers, and within them there are loose cylinders with rims resting on the tops of the collars, and capable of being turned round, so that openings made in their sides and bottoms may coincide with openings which admit the draft from the fire to pass around boilers contained within them, or refuse a passage to such draft. The claim is to "the cylinders, both outer and inner, made and constructed as described, and placed and used in manner aforesaid."

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365. For an improvement in the mode of *Applying the Driving Wheels of Locomotive Engines;* Andrew M. Eastwick, city of Philadelphia, November 20.

"In my locomotive engine I use eight wheels, two pairs of driving, and two pairs of guide wheels; the latter not differing at all in the manner of arrangement or operation from such as have been heretofore employed. My improvement consisting entirely in the mode in which I construct an

independent frame, or truck, to receive the axles of the four driving wheels and in which I connect the same with the main frame of the locomotive."

The independent frame which carries the four driving wheels, has a projecting piece, or gudgeon, on the centre of each of its sides, which extends out, and enters slots in pedestals on either side of the main frame. The springs above the frame act upon sliding boxes in these pedestals through the intervention of bolts, in the ordinary way. The independent truck has, consequently, a vibratory motion lengthwise on the gudgeons of the frame, whilst it yields laterally by the action of the springs.

There is a contrivance described for throwing a larger portion of the weight of the engine than usual upon the driving wheels. This is effected by means of a bolt and screw nut, acting upon the engine frame, and upon the independent truck of the driving wheels, so as to draw them together, and perform a lifting action upon the guide wheels.

"What I claim as my invention and wish to secure by Letters Patent, is the employment of four driving wheels in a locomotive engine, in such a manner that these wheels shall have the bearings of their axles in an independent frame or truck, connected with the main frame of the locomotive, substantially in the way herein described. I also claim the transferring of any portion of the weight usually borne by the guide wheels, on to the driving wheels, upon the principle by me set forth."

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366. For an improvement in the *Horse Rake*; David Dewey, Pultney, Rutland county, Vermont, November 23.

The teeth of this horse rake are to be "of iron or steel, from one quarter to one half an inch in diameter, and are three feet long. They are bent at right angles one foot from their ends, forming a perpendicular of one foot, which bears upon the ground when the rake is in motion. From these angles the teeth extend two feet horizontally forward to the head of the rake, to which they are confined by nuts and screws. What I claim as my improvement in the above described machine, is the iron or steel, or other elastic rods, or teeth, as above specified."

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367. For an improvement in the *mode of constructing Double Centered Joints, Butts, or Hinges;* Egbert Hedge, Hartford, Connecticut, November 23.

These hinges resemble card table hinges, to which as well as to other purposes it is intended to apply them. The principal object of the patentee, however, is to use them as rule joints, as in this case the rule when closed has no projecting joint at its end, but all is flush with the end of the rule. As ordinarily made, however, with two joint pins, they would not open and close with truth, and to insure this they are made with cogs, or teeth, on the connecting piece and on the joint part of each of the brass straps, which for this purpose are finished off to a curve, of which the joint pin is the centre. The claim is to "the cogs or teeth in double centered joints, to insure the accurate and equal turning upon each centre, in the process of opening and closing the joint, and to keep the parts of the joint in their due positions when at rest either closed or opened."

This construction is ingenious in its application to rules, but we are apprehensive that, when its greater complexity, and liability to be out of order, are taken into the account, it will be found to be more curious than useful.

368. For an improvement in the *Reaction Water Wheel;* Nelson Johnson, Erwin Centre, Steuben county, New York, November 23.

This, so called, improvement, is at least an addition to the number of reaction water wheels on record; it does not, however, pretend to much originality, and we apprehend that its deficiency in this point will not be made up by a superabundance of utility. There is to be a bulk head into which the water is to be admitted at top, whence it is to pass through two reaction water wheels on opposite sides of it, the bulk head being perforated to receive them. The perforations are to be conical, or funnel shaped, and to these the wheels are to be adapted. The invention claimed is the "making the outer and inner rims of the reaction wheels, between which the buckets are placed, in the shape of a section of a cone."

369. For an improved mode of *regulating the motion of the Yarn Beam in the Power Loom;* Welcome A. Potter, Cranston, Providence county, Rhode Island, November 23.

Most of the appurtenances to looms are of a nature not to be readily described in words, although they may not appear intricate when seen by those acquainted with such matters. The claim would not throw any light upon the construction of the apparatus which is the subject of the above named patent, and it is, therefore, omitted.

370. For an improvement in the *Plough;* Bancroft Woodcock, Mount Pleasant, Westmoreland county, Pennsylvania. First patented June 14th 1837. Patent surrendered and reissued November 23.

What I claim in reference to the share is the making it with plain surfaces instead of curved ones, continuing those surfaces with a shoulder on each side, so as to leave the metal throughout so thin that when it wears off by use, the share will still present a thin edge to the ground. I claim also the reversing cutter received into a recess on the land side, and capable of having either of its edges presented forward so as to form the cutting edge of the plough, and secured in its place, on the land side by a wedge, or wedges, or in any other manner which may be preferred. I likewise claim the mode of forming the renewable point, as set forth, and the dovetailed or acute angular form given to the shank of the renewable point, for the purpose of clasping, or holding down the renewable cutter."

371. For improved *Mills for Grinding Grain, and other articles;* Elijah S. Curtis, city of Boston, November 23.

The specification of this patent. with an engraving, is expected to be published in the next number of this Journal.

372. For an improvement in the *Steam Boiler;* James M. Whittimore, Brighton, Middlesex county, Massachusetts, November 23.

This is a vertical cylindrical boiler, with a furnace occupying its centre, as in many other steam boilers. The water surrounds the fire, the cylinder containing it extending down to the top plate of the ash pit, which is constructed in the ordinary manner; but it is, also, to constitute a wind box, into which air is to be blown by means of a wind wheel. The vertical cylindrical boiler is surrounded by two other cylinders, the spaces between which are for a descending and ascending flue, for the heated air; they extend down to the ash pit plate, and each of them has a top, or cover,

either flat or convex, forming flues connected with those formed by the cylinders. The heated air ascends through a pipe in the centre of the furnace, extending into the inner flue space, down which it descends until it reaches near to the bottom, where there are holes admitting it to pass through into the outer space, up which it ascends, and escapes by the chimney. The claim is to the construction and combination of the flues, &c. as set forth.

We are at a loss to discover the advantage of the outward draft space in which the heated air is not in any part in contact with a surface exposed to the water of the boiler. The novelty of construction is but small, and where it exists we are unable to discover utility.

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373. For an improvement in *Wind Mills;* Jacob D. Makely, Cairo, Greene county, New York, November 23.

There is a peculiarity in this wind mill which we believe gives to it a claim to novelty; it consists in making separate foundations for the part sustaining the wings, and that containing the stones, or other machinery to be driven. The patentee says, "I do not claim the principle of placing a wind wheel and its frame upon a circular railway, nor of drawing the surface of the vanes in the wind by cords and pulleys, and regulating the same by weights. But what I do claim is the method of constructing the wind wheel with its frame and swivel placed on a circular railway on the ground, and detached from the building containing the machine or mill to be propelled; the whole combined substantially as herein described. Also the long mortise in the shaft, and the sliding belt, bar, and rod, combined with the other parts for regulating the vanes, as described."

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374. For an improvement in the machine for *Thrashing and Winnowing Grain;* Moses Davenport, Phillips, Somerset county, Maine, November 23.

The claim is to an "endless revolving elevator, with the inclined board which conveys the grain to a fan placed below the thrashing cylinder, in the manner described."

This thrashing machine does not differ from others; the elevator is an endless apron consisting of straps passing round rollers, and crossed by slats which sustain and carry off the straw, whilst the grain falls through upon an inclined board, which conducts it to a fan wheel. The novelty is very small, as will be seen by those conversant with what has been previously done, in the construction of similar machines.

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375. For a *Pistol Sabre;* Robert B. Lanton, city of New York, November 23.

This is another addition to the means of killing our fellow men with great facility. "The principal feature of the invention consists in combining a number of pistol barrels in a revolving cylinder, with a sabre in the centre, on the shank of which the cylinder revolves, between it and the handle, the barrels being caused to revolve by the movement of cocking, in a manner hereafter described."

"The invention claimed by me, and which I desire to secure by Letters Patent, consists in combining a revolving cylinder of parallel barrels, with a sabre, in the manner described, and causing it to revolve

on the shank of the latter, between the shoulder and handle; and the method of turning the cylinder of barrels, as set forth, by the movement of cocking the hammer."

376. For an improvement in *Spring Saddles*; Harman C. Fisher, Warwick, Kent county, Rhode Island, November 25.

"What I claim as my invention, is the application to mens' and womens saddles, of spiral springs between the saddle tree and pad, as described; using for springs any metal which will produce the intended effect."

The spiral springs are to be placed between boards, &c. and are to operate in the manner of those used in sofas, carriage seats, &c.

377. For an improvement in *Spring Saddles*; John D. Payne, Warm Springs, Bath county, Virginia, November 25.

"This improvement consists in two taper, curved, flat steel springs over the seat of the common saddle, placed side by side, and fastened by screws passing through the smaller ends into the pummel of the saddle, the wider ends resting upon the cantel, and having slats or oblong mortises in said wider ends, which move over the shanks of screws inserted into the cantel to keep said springs in their proper places."

"The invention claimed consists in the before described arrangement of curved, flat, tapered springs, extending from the pummel to the cantel of the saddle above the ordinary seat, fastened permanently by the smaller ends to the pummel, the larger ends moving freely over the cantel, said springs being covered with a padding, forming a second seat above the covered seat of the common saddle."

378. For an improved *Mill for grinding Bark, Corn, &c.*; Charles Parker, Meriden, New Haven county, Connecticut, November 25.

This is an iron, or steel, mill, with a conical nut running in a corresponding rim. The only peculiarity in it consists in having the lower edge of the nut so formed that it shall constitute a toothed wheel, and be driven by means of a pinion upon a shaft adapted to that purpose.

379. For an improvement in the machine for *Ginning Cotton*; F. Goodell, E. Brown, E. Tracy, and L. H. Mosely, assignees of John Stevens, Poughkeepsie, Dutchess county, New York, November 25.

This improvement is on the roller gin, for long stapled cotton. Various materials have been tried to constitute the surfaces of rollers for such gins; it being necessary that the rollers should take hold of the cotton with sufficient force to separate it from the seed, whilst it shall not adhere with such tenacity to the rollers as to be carried round by them, and in consequence become entangled. Most commonly the rollers have been made either of wood, or of metal; in the present instance one of them is made of metal, and grooved upon its surface spirally from the centre towards either end, so as to direct seed cotton along it; the other is formed of disks of cork, passed upon a suitable iron shaft, and pressed together by screw nuts so as to form a hard elastic surface, which is then to be made true and even. The claim is to "the application and manner of making the cork rollers, and the spiral grooved metallic rollers."

380. For an improvement in the *Machine for Ginning Cotton;* Lucilius H. Moseley, Poughkeepsie, Dutchess county, New York, November 25.

The design of this gin is the same with the foregoing; the only difference being in the employment of other materials to effect the same purpose with the metal and the cork in the former. Instead of the cork, disks of paper are to be pressed on to a shaft, as is done on calendering, and sometimes on paper, mill rollers. On the other rollers the surface is to be formed either of stone, or of baked clay, with a surface like biscuit, or hard unglazed earthenware. The claim is to the application of paper, stone, and burnt clay, as rollers for cotton gins.

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381. For a *Horse Power;* Benjamin Hinkley, Fayette, Kennebec County, Maine, November 25.

A circular railway is to be made, about ten feet in diameter, an edge-rail of iron being affixed to its upper surface. A wheel, or platform, somewhat smaller in diameter than the iron rail, is to carry on its periphery a number of rollers, grooved to adapt them to the edge-rail, and turning upon suitable gudgeons. Over these is another circular platform, about twelve feet in diameter, upon the surface of which, near its periphery, the horse, or horses, are to be placed, there being suitable rails to keep them in place, and to which to attach them. The platform may be grooved on its edge to receive a band, by which whirls or pulleys, may be driven. The claim is to "the wheel of truck rollers, in combination with the circular revolving platform, or horse wheel."

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382. For an improvement in the apparatus for *Boring the Hubs of Wheels;* James Hinds, Troy, Rensellaer county, New York, November 25.

This tool consists of a mandrel, one end of which is to be received upon a centre screwed into the latter mandrel, the other being sustained by the front centre. This mandrel may be made square, or it may be round and have a feather along it, as it is to form the slide of a tubular piece of steel, or iron, which is to fit it truly, but not to turn upon it; this tube is to be enlarged at one end, so as to be mortised out to receive a cutter, in the usual way. The wheel to be bored, is secured upon a face chuck; a dog may then be fastened on to the sliding tube, at a distance from the cutter, its projecting part bearing upon the lathe rest, when by turning the lathe, and causing the cutter to advance, the boring will be effected. If the hole is to be taper, the front centre is to be placed in a corresponding sink, or prick punch hole, out of the centre of the mandrel upon which the cutter tube slides. The claim is to a tool constructed in the manner above described.

Whether there is here enough of novelty upon which to sustain a patent is a doubtful point. Straight and taper holes have been bored by means very similar to, and producing the same effect with, that described.

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383. For *Springs for Wagons, Carriages, &c.:* Porter Hill, Veteran, Chemung county, New York, November 25.

These springs are to consist of curved bars of steel, so arranged that the convex part of one of the bars shall bear upon a similar convexity

upon another. Different modes of so arranging them are presented by the patentee, but we do not think it necessary to take the time and trouble necessary to explain them. If they ever come into general use our readers will see them for themselves.

384. For an improvement in the mode of *Weaving Hair Seating;* Charles R. Harvey, Poughkeepsie, Dutchess county, New York, November 25.

The claims made are to "the particular manner of operating and working the hook, by the transverse cam, and its connecting fixtures. Also the general arrangement of the loom, most of the parts being old, and common methods, but in this loom so combined as to produce a new result, to wit, the weaving of hair seating by a power loom." This we shall not be expected to describe.

385. For improvements in the *Figure Power Loom;* William Crompton, Taunton, Bristol county, Massachusetts, November 25.

As respects verbal description, all looms are pretty much in the same predicament; they require to be seen, in order to their being understood. The claims in the present instance are to "the entire manner of constructing and combining the apparatus for working the jacks, as described, consisting of the lifting and depressing rods; the rods with rollers for throwing out the jacks, arranged upon a cylinder, or otherwise, the lifting rods, and the upper shaft with its connexion by gearing with the roller cylinder. Also the two notched wheels upon the upper shaft, as constructed, combined, and used, for working the pick."

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a Patent for the manufacturing of Colouring Matter, applicable to Dyeing, Staining and Writing; granted to HENRY STEPHENS, *of Great Britain, October* 23, 1837.

To all whom it may concern, be it known, that I, Henry Stephens, a subject of the Queen of Great Britain, and now residing in Charlotte street, in the Parish of St. Mary-La-Bonne, and County of Middlesex, in the said Kingdom, have invented or discovered a new and useful invention of certain improvements in manufacturing colouring matter, and rendering certain colour, or colours, more applicable to dyeing, staining and writing. And I do hereby declare, that the following is a full and exact description thereof:

My improvements in manufacturing colouring matter, and rendering certain colour or colours more applicable to dyeing, staining and writing, consists in the first place, of improvements in making or manufacturing the Ferro Prussiates (that is, Prussiates of Potash and Soda;) and secondly, in rendering Prussian Blue soluble, and thereby more applicable than heretofore to the purposes of dyeing, staining, colouring and writing, which improvements I am about to describe under different heads or sections, (that is to say,) My first improvement consists in converting certain gaseous products arising from the present mode of making Prussiate of Potash or Soda from animal matter (which are now commonly allowed to escape into the atmosphere)

to the purpose of making Prussiate of Potash or Soda, so that an increased quantity of Prussiate of Potash or Soda may be obtained from a given quantity of animal matter. For the better explanation of this part of my invention, I refer to the annexed drawings, in which Fig. 1.* represents an apparatus for effecting the process of converting the gas evolved into prussiate—*a*, is an iron pot, vessel, or retort, charged with alkali and animal, or other, matter, containing azote, or yielding ammonia, which vessel is to be heated to a low-red heat. This pot, or vessel, has a movable cover which is to be luted on when under operation, but may be removed and placed upon another pot, *b*, by disconnecting the joint in the pipe, *c*, the joint allowing the head of the pipe, *a*, to be carried round with the connecting pipe *c*. The pipe *c*, is for conducting the gaseous products arising from the decomposition of the said animal matter in the pots *a* or *b* into an iron, cylindrical, or other conveniently shaped, vessel, *d*, heated by a furnace, *h*, below. This vessel, *d*, is to be charged with alkali, and to be kept at a full red heat during the operation; *e*, is a pipe leading from the cylindrical vessel to a closed vessel, *f*, containing a solution of alkali. This vessel is furnished with a jet pipe, or burner, *g*, which is merely intended as a gauge cock, to ascertain the state of the gas within—*i*, *i*, are furnaces under the pots *a* and *b*. The gas generated in the retort, *a*, passes by the connecting pipe, *c*, to the cylinder, *d*, where meeting with the alkali in a state of fusion, the effect will be that the gas becomes combined, to a certain degree, with the alkali and forms Prussiate of Potash or Soda. But there may be portions of the said gas which do not combine, or commix, with the alkali; these will pass off by the pipe *e*, to the closed vessel, *f*, and if any of the gas thus passed off should be capable of combining with the alkaline solution, it may do so in the closed vessel, *f*, and that portion which does not combine with the alkaline solution is allowed to pass off by the gas jet-pipe, *g*; the state of operation may be ascertained by burning the jet gas from the end of this pipe, for when it ceases to burn freely, the connexion between the pot, *a*, and cylinder, *d*, should be disconnected, and the head and pipe, *c*, be removed round and luted on the pot, *b*, which is to be previously charged with animal matter and alkali, the distillation of which will proceed as before described. When the gaseous products of several charges have been passed through the cylinder *d*, containing the alkali, the cylinder may be opened and the charge (which will now consist of crude Prussiate of Potash or Soda—or "metal" as it is commonly called in the trade,) be withdrawn into an iron vessel, and when cold be lixiviated in cold water in the usual manner. The further decomposition of the charge of animal matter, in the pot, *a*, may now be conducted in the ordinary manner of making Prussiate in the open vessel by increasing the heat, the contents to be agitated as usual. This process may be repeated alternately in the two pots, *a* and *b*, the completion of the decomposition of the charge of one being effected, while that of the other is subjected to the lower heat, and the operation of distilling off its vapours and passing it to the retort, or vessel, *c*.

A similar effect, (viz.) that of taking up the gaseous products so as to produce an additional quantity of crude Prussiate of Potash, or "Metal," may be obtained in an open, conical chimney, having a false bottom, or grate, or perforated plate, upon which dry potash, or soda, is placed so that the gas generated in the pot below may pass through the stratum of alkali in the chimney.

Fig. 2. is a sectional elevation, representing this application of my im-

* These figures are not given, as they are such as are ordinarily used by chemists.

provement : E, is the chimney, or open cone, usually placed on the top of an ordinary pot, F. for making Prussiate of Potash, in order to convey the flame upwards. G, is a grating, or perforated plate, placed at the base of the cone, E. Upon this grating, or perforated plate, G, a stratum of dry Potash, or Soda, is laid, and as the gas passes upwards through this stratum, a portion of it will become combined with the alkali. The chimney, with the stratum of the alkali, may be removed when the flame begins to burn weak, and it may be set aside and applied to future charges, or put into the pot and worked off with the charge in the usual manner of making Prussiate of Potash or Soda.

My second improvement, (viz.) the mode, method, or process, of treating, or operating upon, Prussian Blue, so as to render it more perfectly soluble, or more readily disposed to be acted upon by the subsequent process of solution, than when manufactured in the usual way, and in order that the same may be more applicable to the purposes of dyeing, staining, colouring and writing, I effect in the following manner:

I take the Prussian Blue, whether produced from a combination of Prussiate of Potash and Salts of Iron, or the Prussian Blue of commerce as commonly manufactured, and I put this into an earthen vessel and pour over it a quantity of strongly concentrated acid, sufficient to cover the Prussian Blue; Muriatic acid, Sulphuric acid, or any other acid which has a sufficient action upon iron, will do, but I prefer the Muriatic acid. If Sulphuric acid is used, it should be diluted a little, that is a quantity of water equal to about its bulk, at the time when the mass burns white after the Prussian Blue is put in. The Prussian Blue is to be allowed to remain in the acid from 24 to 48 hours, or longer. I then dilute this mixture with a large quantity of water, stirring it up at the time, for the purpose of washing from it the Salts of Iron. When in this state of dilution, I suffer it to stand until the colour has subsided, when the supernatant liquor is to be drawn off with a syphon, and more water added to it, and I continue the repetition of this process until I judge that the acid, with the iron, has been completely washed away, and this is known by testing it with Prussiate of Potash, which will show if it yields any blue precipitate; if not, it is sufficiently washed; I then place it upon a filter and suffer it to remain until the liquid has all drained away.

The Prussian Blue thus prepared is reduced to a state, as I conceive, containing less iron than the Prussian Blue of commerce, in which state it is more readily acted upon and rendered soluble, than in any other condition. This Prussian Blue may be then placed in evaporating dishes, and gently dried. To form the Prussian Blue so operated upon into a solution, I add to it Oxalic Acid, and mix them carefully together; after which I add cold water (cold distilled water is best) a little at a time, making it into a dense or dilute solution, according to the colour required. The quantity of Oxalic acid may vary according to the quantity of water used. It will be found that the Prussian Blue that has undergone this process of digestion, as described, requires but a small quantity of Oxalic acid to dissolve it. About one part of Oxalic acid will dissolve six parts of Prussian Blue, (the weight taken before digesting in the acid.) This will answer for a concentrated solution, but for a dilute solution, more acid will be required. Prussian Blue that has not undergone digestion in acid in the way above pointed out, will require a much larger proportion of Oxalic acid, from twice to three times its weight, and then it will be greatly liable to precipitation after standing; but when treated in the way described, it is not liable to precipitate, but remains a permanent solution.

The chief obstacle to the general employment of the beautiful colour obtained by means of the Ferro Prussiates to the purposes of dyeing in the silk, cotton, linen, or woollen manufactures, and also to the purposes of staining and writing, has been its hitherto supposed indissoluble nature; but by means of Oxalic acid, (whether obtained by the usual process of mixing or distilling saccharine matter in combination with nitric acid, or from vegetable, or other, substances containing Oxalic acid, or from combinations of Oxalates, whether metallic, earthy, or alkaline,) I obtain the above perfect solution of the Prussian Blue, which is applicable to dyeing, colouring, or staining, in the various manufactures of woollens, silks, linens, cotton, paper, and such other substances as are required to be dyed, or stained, and which solution is also available to the purpose of writing, or forming a writing fluid, or ink, to be used with steel, quill, or other, pens.

In conclusion, I desire it to be understood that I do not claim any of the apparatus, or machinery, described, nor the calcination of animal matters in close vessels, but I do claim the method of obtaining a product of Prussiate of Potash, or Soda, from the gases evolved from the distillation of animal matters, or any other matters that yield Azote and carburetted Hydrogen, such, for instance, as coal, by means of passing those gases into the mass of alkali in a state of ignition, and into a solution of alkali contained in separate vessels, either closely, or distantly, connected with the distillatory apparatus.

Secondly—I do not claim the use of acids for the purpose of brightening, or improving, the colour of Prussian Blue in the ordinary manner. But I do claim the use of strong acids for the purpose of digesting dry Prussian Blue of commerce, in order to render it more easily soluble in the Oxalic acid, than it would be without such a digestion. And I further claim the use of Oxalic acid, however obtained, as a solvent for Prussian Blue generally, but more especially, as a final process for making a perfect solution of the Prussian Blue which has been prepared and digested in the manner above described.

HENRY STEPHENS.

Specification of a Patent for a Fire Proof Paint; granted to LOUIS PAIMBŒUF, *City of Washington, D. C., November* 11th, 1837.

To all whom it may concern, be it known, that I, Louis Paimbœuf, of the City of Washington, in the District of Columbia, have invented an improved mode of preparing Paint for the protection of buildings against fire; and I do hereby declare that the following is a full and exact description thereof:

My fire-proof Paint may be prepared by grinding and incorporating the ingredients used, either with oil, or with water as may be preferred. That prepared with water or other aqueous fluid, however, has one advantage over that prepared with oil; namely, it dries very rapidly, and affords the desired protection immediately; whilst that prepared with oil, will not harden until the lapse of several weeks, depending upon the season of the year.

To prepare my paint, I take the best quick lime, such as when slacked forms an impalpable powder, and slack it by the addition of so much water, only, as is requisite to produce that effect, performing this ope-

ration in a trough, or vessel, which may be covered over, so as to retain the vapour and heat as perfectly as possible, as upon this procedure I find that much of the effective strength of the composition is dependent.

When the slacking has become perfect, and the mass has cooled, I, in order to prepare my water paint, add either water or skimmed milk, or a mixture of the two, to the lime, in sufficient quantity to give to it the consistency of cream, or that of ordinary paint. When milk is not used, I add to the water a quantity of rice paste, made by boiling rice in water to a proper consistence, using about eight pounds of rice to every hundred gallons of the prepared paint. To every hundred gallons of this prepared lime mixture, I add twenty-pounds of alum, fifteen pounds of potash, and one bushel of common salt. These are the essential ingredients, and the proportions such as I have found to answer well. If the paint is to be white, I find it advantageous to add to these ingredients about six pounds of prepared Plaster of Paris, and the same quantity of fine white clay. When the paint is not required to be white, I substitute clean, well-sifted, hard-wood ashes for the potash; about two bushels being sufficient for the above quantity; in this case, also, I frequently add three, or four gallons of molasses.

After mingling these ingredients, I first strain them through a fine strainer, and afterwards grind them together in a paint mill, when the paint is ready for use. When roofs are to be covered, or when crumbling brick walls are to be coated, I mix with my paint a quantity of fine white sand, in the proportion of about one pound to every ten gallons of the paint, as this addition will cause the paint to petrify, preventing leakage in roofs, and binding the crumbling particles of disintegrating brick work.

In applying this paint, excepting in very warm weather, it will be advantageous to use it as warm as it can be conveniently kept; and particular care must be taken that it be not allowed to freeze whilst drying, as its binding property would thereby be destroyed, or much impaired. Three coats will be sufficient in all cases. In putting on the first coat, the paint should be more diluted than with the others. It can be managed by any person used to the paint brush.

When the oil paint is to be prepared, I take forty gallons of good, boiled, linseed oil, and to this I add such quantity of the fine, dry-slacked lime as is requisite to bring it to a proper consistence for paint, and to this add two pounds of alum, one pound of pot, or pearl, ashes, and eight pounds of common salt. In this paint, good wood ashes may be substituted for the potash, eight, or ten pounds being used.

This paint is to be used in the same manner as other paint, taking special care that the first coat is perfectly dry before the second is applied. Under the same circumstances, the addition of a portion of white, fine sand, will produce a like good effect as in the water paint.

With these paints any of the ordinary pigments may be used, so as to obtain any colour which may be desired.

I do not claim to be the first who has applied the above-named ingredients to the purpose of rendering wood incombustible, either separately, or, to a certain extent, in combination with each other; but what I do claim as my invention, or discovery, is the combining together of lime, potash, alum and common salt, substantially in the manner herein set forth; whether the same be in the proportions herein designated, or in any other which will produce a like effect, and whether the other

ingredients named, or any similar substances, be added to the water, or the oil paint, prepared as above. LOUIS PAIMBŒUF.

Remarks by the Editor.—When the foregoing composition was first introduced in the city of Washington, it attracted considerable attention, in consequence of some public exhibitions made for the purpose of showing its efficacy, and which were, so far as they went, satisfactory. The small, wooden erections upon which these experiments were performed, had been recently, and very carefully, covered with the composition, and the question was one of much importance, how long will the protective effect continue? Will the paint, or work, stand exposure to the weather, or will it wash, or shell off? To these questions the reply of the experimenter was, that he had roofs covered with it in the West Indies, and that it was good after a lapse of five years. This assurance induced a number of persons to make essays with the material, and it was soon found that it would both shell and wash off, at an early day, and that it was, consequently, of no value whatever. Prior to this, the nature of the composition had not been made known, but an application for a patent necessarily called forth the recipe.

Those who are acquainted with the many experiments which have been instituted for the purpose of rendering timber fire proof, will not meet with any thing substantially new in the foregoing plan; all the essential ingredients, as well as many others, analagous in their properties, have been essayed, and the result made public. The propriety of granting a Patent was questioned, but it was considered as limiting the patentee to his own particular combination of ingredients, by which the public interest would not be invaded. Twenty compounds equally good, and some better, may easily be prepared, were they worth preparing. Had that in question been faithfully made, by a proper incorporation of the ingredients, and the employment of a sufficient portion of those which were known to be the most beneficial, the eventual failure would at least have been postponed, and would have been less complete.

Specification of a Patent for a Machine for separating Garlic from Grain; granted to HENRY STRAUB, *Shepherdstown, Jefferson County, Virginia, November* 11*th*, 1837.

To all whom it may concern, be it known, that I, Henry Straub, of Shepherdstown, in the County of Jefferson, and State of Virginia, have invented an improved Machine for separating Garlic from Wheat, or other small grain, and which will be found applicable to other purposes; and I do hereby declare that the following is a full and exact description thereof:

A cylinder is made to revolve, within a frame, by any suitable means. This cylinder, I cover over its whole periphery, with elastic teeth of wire, or with narrow elastic strips of metal, secured upon it by any suitable means. This wire, or these metallic strips, must be of such strength as will enable them to crush the heads of garlic, and reduce them into small fragments. The size of such wire, or strips, must be regulated by the material of which they are made; iron teeth, for example, will require to be stouter than those made of steel. I usually make them

about an inch long, but it may be found advantageous to vary this according to the size of the machine, and other circumstances. These teeth, of course, surround the cylinder.

A concave extends about one-fourth of the way round the cylinder; this is formed of rods, or strips of iron, of such thickness as shall be sufficient to preserve them from bending; the strips extend from side to side of the machine, and are placed so near to each other as not to allow a sound grain of wheat to pass between them; they are to have stays between them at suitable distances, to prevent their springing. I employ a feed board, down which the grain is allowed to run, and by which it is fed, in between the revolving cylinder and the concave. The edges of the strips should be square, and their angles sharp; and the teeth on the cylinder must be very nearly in contact with them.

In operating with this machine the heads of garlic, being softer than the grain, will be broken up by the action of the teeth against the concave of iron slats, between which the larger portion of the fragments will pass, and those which may fall down with the grain may be readily separated by screening.

What I do claim as my invention, and desire to secure by Letters Patent, is the separating of Garlic from Grain by passing the same between a revolving cylinder, and a concave of iron, the cylinder being covered with teeth, and the concave formed of strips, in the manner herein set forth. Henry Straub.

Specifications of a Patent for an improved Apparatus, which may be used as a Life Boat, and for other purposes; granted to John Macintosh, *City of New York, November* 11*th*, 1837.

To all whom it may concern, be it known, that I, John Macintosh, of the City of New York, have invented a new and improved Apparatus which may be used as a Life Boat for the saving of persons and property, for the conveyance of troops, baggage, and other articles, across rivers, &c., and for various other useful purposes; and I do hereby declare that the following is a full and exact description thereof:

I take canvas, or other flexible material, and render it impervious to water by means of a solution of caoutchouc, or in any other of the known ways of effecting this object; and of this flexible material, so saturated, I make my vessel, which is to contain the persons, or things, intended to be buoyed up, and conveyed upon the water. Such a vessel may be made to assume a variety of forms, dependent upon the purpose for which it is to be used, whether for one or more persons, the transportation of troops and baggage, and for other objects. The manner in which I intend, most commonly, to construct such a boat, or vessel, is the following:

I take a square piece of canvas, or other material, saturated as above stated. The edges are to be turned over, in the manner of forming a wide hem, so as to leave what, when filled with air, will become a tube, or air-chamber; the turned-over edges being securely cemented down, taking care that the juncture is air-tight. The material is then doubled over, so as to bring the opposite edges together; and the edges of the doublatures are united by cementing, or otherwise, as are also the edges

of the tubes, or air-chambers, so as to cause them to form a continuous air-tight rim, when, if the sides are separated to some distance apart, it will constitute a vessel resembling a boat. A small hose, or tube, furnished with a stop-cock, leads into the air-chamber, which may be inflated in a few moments by applying the mouth to the stop-cock. Instead of a single air-chamber, there may be two or three, one immediately under the other; when, should one be accidentally ruptured, no inconvenience would result therefrom.

It will be evident that a vessel so constructed will float in the water from the buoyancy derived from the air-chamber, and that its lower, or bag part, will also remain at the surface, or nearly so; but if persons, or any weighty articles, are placed upon this part, it will sink so as to displace a portion of water equivalent in weight to itself, if its specific gravity be not greater than that of water, and that in this way, it may be loaded, whilst the tubular part, or air-chamber, will remain at the surface, occupying the situation of the gunwale of a boat.

To form a covering to the persons, or things, contained in the vessel, pieces of air-tight canvas, or other material, may be attached round the air-chamber, and may be folded, or drawn, over the persons, or things, contained in the vessel. In some cases, it may be found desirable to leave an air-opening in the covering, which opening may be surmounted by a conical tube, or other device, for admitting air, and keeping out water.

Oars, or paddles, may be used to give a direction to such vessels; and where, for the conveyance of troops, or for any other purpose, a number of them are to cross any water, a tow-line may be carried by the first, and employed to draw the others over. For the purpose of using oars, there should be thongs, at suitable places along the edges, which, when tied together, will form loops through which the oars may pass. Other devices for propelling may be used; as, for example, a triangular, or other, float board, having a line attached to it, in the manner of a log line, may be thrown out by a person in the vessel, when by drawing the line, the vessel will be propelled, or drawn, towards the float board.

By means of thongs attached to the edges of the air-chamber, the sides of the tubular air-chamber may be made to approach each other in any part desired, and any required form be given to the outline of the vessel, by merely tying these thongs together.

Where it is desired to apply the principle to ships, steam boats, &c., the bag part need be but little larger than will suffice to contain one or two persons only, and such articles as they may desire to have with them, this may be effected by having the berth matrasses of any ship, steamboat, &c., cut into two parts lengthwise, and covered with caoutchouc, or with other water-proof flexible material, as aforesaid, to take the place of tubes, with the bag of the aforesaid material, placed between the two parts of the matrass; and in this case, it will be found convenient to attach flexible legging to the bottom of the bag to receive the legs and feet. A person may then carry the whole in his hands, walk about readily, and jump from a vessel, or wharf, into the water, and when there, may use his feet and legs to enable him to swim backwards.

With an apparatus of this kind, a covering may be used which may be drawn round the neck, over the head, or under the arms, of the person, as may be desired; and, indeed, this and other parts of the apparatus are susceptible of numerous modifications, which, as they are de-

pendent upon the judgment, or the fancy, of the person using it, it would be impossible to enumerate.

When the matrass of a vessel is used to form the gunwale of the Life Boat, such matrass may be made in two thicknesses, which, when used as a matrass, lie upon each other, but when opened out, will form the gunwale, the bag part depending from its lower edges. Or, the matrass may be cut into two parts, along its middle, so as to consist of two narrow matrasses of half the usual width, which lie side by side when in the berth, but when used as a Life Boat, then open out, the bag, as before, depending from their edges; in this case, as the two parts of the matrass are not continuous, they are to be connected by water proof ends, consisting of cloth which may be drawn up in any convenient way. This mode of using the matrass I prefer; the gunwale part being, in this case, of half the width and double the thickness of that first described, which I find to be advantageous.

What I claim as my invention, and wish to secure by Letters Patent, is the constructing an apparatus, or vessel, wholly of such flexible materials, as are herein described; one portion of which material shall constitute an air-chamber, or air-chambers, which may be readily inflated by the mouth; or made of any flexible article whose specific gravity is less than that of water; such as the materials which are commonly used in ship's berth matrasses, and filled with hair, straw, &c.; whilst the other portion thereof shall contain a bag, or receptacle, to contain persons, baggage, goods, ammunition, &c.; and this I claim, whatever be the form given to such vessel, bag, or receptacle, or to any covering which may be used therewith, whilst it is constructed so as to operate substantially in the manner, or upon the principle, herein set forth.

JOHN MACINTOSH.

Progress of Practical and Theoretical Mechanics and Chemistry.

Protection of Iron by Zinc.

The invaluable discovery by M. Sorel, of an effectual and cheap method of preserving iron from rust, or corrosion, by zinc, described at page 52 of the present volume, has occasioned the formation of a Galvanized-metal company for the manufacture of zinced Iron, and the extension of its use throughout Great Britain. The happy solution of this long sought chemical problem, which will doubtless be productive of immense economy in the use of a metal, the demand for which must continually increase faster than the possibility of its adequate production, must hereafter constitute, like the steam engine, one of "the most valuable presents from philosophy to the arts." The following testimonials to the soundness of the principle and value of the discovery, are from the prospectus of the English, Scotch, and Irish Galvanized-metal Company. G.

M. Sorel, a French chemist, after many years of study and experiment, discovered an application of a scientific principle for preventing the oxydation or destruction of metals, particularly iron, as effectual as it is simple and inexpensive. His discovery is protected by a patent in France where, for some

months, the process has been in successful operation. Patents have also been granted for the invention in the United Kingdom.

The discovery has been submitted to the consideration of the following eminent British chemists:—W. T. Brande, F. R. S., Professor of Chemistry to the Royal Institution; J. G. Children, F. R. S.; Thomas Graham, Professor, London University; A. Garden, M. R. I.; Richard Phillips, F. R. S.; and such of the Reports of those gentlemen as have been received are annexed.

By Professor Graham, of the London University.

The effect of zinc in protecting iron from oxydation has been known to chemists for some time. When these two metals are in contact, an electrical or galvanic relation is established between them, by which the iron ceases to be susceptible of corrosion by dilute acids, saline solutions, or atmospheric humidity. It was found in experiments lately conducted at Dublin and Liverpool, that small pieces of zinc attached to each link of a chain cable were adequate to defend it from corrosion in sea water. The protection was observed to be complete, even in the upper portion of the iron chains by which buoys are moored, and which, from being alternately exposed to sea water and air is particularly liable to oxydation, so long as the zinc remained in contact with the iron links. The protecting influence of the zinc could not be more certainly secured than in the articles prepared by the patent process, the iron surface being uniformly coated over by that metal. In trials, to which I have had an opportunity of subjecting them, the iron escaped untouched in acid liquids, so long as a particle of the zinc covering remained undissolved. The same protection is afforded to iron in the open atmosphere by zinc, with a loss of its own substance, which is inappreciably minute. The zinc covering has the advantage over tinning, that, although it may be worn off and the iron below it partially exposed, the iron is still secured from oxydation by the galvanic action, while the smallest quantity of zinc remains upon it; whereas tin in common tin-plate, affords no protection of this kind, and not being absolutely impermeable to air and moisture, the iron under it soon begins to rust in a damp atmosphere. The simplicity and perfect efficacy, of the means employed to defend iron from the wasting influence of air and humidity in this process of zinc-tinning, certainly entitle it to be ranked as one of the most valuable economical discoveries of the present age.

Thomas Graham,
Professor of Chemistry.

University College, London, April 17th, 1838.

Jointly by J. G. Children, Esq., F. R. S., &c., and A. Garden, Esq., M. R. I., &c.

The so-called galvanized iron consists of iron coated by zinc. The process by which the union of these two metals is effected we are ignorant of, as we have not seen a copy of the French patent, but we conclude that it is somewhat similar to that by which iron is coated with tin, since, that zinc may be so employed instead of the latter metal was pointed out by the Messrs. Aikin in their Dictionary of Chemistry, as long ago as the year 1807. The method adopted by Sir H. Davy, for protecting the copper sheathing of ships by means of some metal whose electrical relations are positive with respect to the copper, may have suggested the idea of a similar protection to iron, and it is obvious to theory, and demonstrated by fact,

that zinc is an incomparably more powerful agent in producing that effect than tin. A material difference, however, exists between the French invention and that of Sir H. Davy, since the English philosopher employed *contact* of the metals only in protecting copper; whereas Monsieur Sorel avails himself of the chemical (or electrical) affinity of the metals in the most extensive and perfect contact in protecting iron.

Certain specimens have been shown to us as the results of comparative experiments made by exposing articles formed of galvanized iron, and similar articles of tinned iron, and of iron in an uncovered state, for several months, to the influence of the atmosphere, in which the iron of the first remains unaffected, whilst that of the two latter is very much oxydated. Time has not been allowed us to repeat this, the most simple and most conclusive, experiment; but those which we have been enabled to make in the short interval that has elapsed since our opinion on the merits of this invention has been demanded, give us every reason to believe that the results alluded to have been honestly obtained, and that they afford decisive evidence of the efficacy and importance of this method of protecting iron from rusting influences.

The experiments we have made consisted in exposing plates of galvanized iron, and similar plates of tinned iron, and of iron altogether unprotected, in separate vessels, to the action of distilled water, a solution of common salt of about the same strength as sea-water, and of diluted muriatic acid. In every case, the unprotected iron and the tinned iron, were acted on and oxydated in a very few hours, and in three days abundance of red oxyde of iron was found to have been deposited in each vessel containing the iron plates and the tinned iron plates; but in those containing the galvanized iron not the slightest trace of red oxyde could be detected, and, except an almost imperceptible discolouration of the zinc surface, which in one or two instances had become a little darker, the galvanized iron was entirely unchanged. A piece of galvanized iron plate and of simple iron plate were also placed *in contact with each other* in distilled water, and another similar pair in a solution of common salt. In three days neither plate showed any symptoms of the iron having been oxydated, so that the protecting power of the zinc of the galvanized iron plate appears to have extended to the iron plate in external contact with it also. It had been suggested to us that perhaps accidental or partial abrasion of the zinc surface might occasion the iron to rust into holes where unprotected. We did not think this likely, nevertheless we put it to the test of experiment, and with a file cut lines into the galvanized plate entirely through the zinc, so as to leave the surface of the iron exposed, and did the same with a plate of tinned iron. In every instance the lines in the latter were filled in a day or two with red oxyde of iron, whilst those in the galvanized iron plate retained their undiminished metallic brightness. We did more,—we dissolved off every particle of zinc from two portions of the galvanized plate—in one case by very dilute muriatic acid, in the other by equally dilute sulphuric acid. As soon as the whole of the zinc was removed, the solution was poured off, and a portion of it, to which some nitric acid was previously added, was tested for iron by pure ammonia; when the only evidence that any portion of the latter metal had been dissolved was a very faint reddish tinge which prevailed through the liquid, but so slight as hardly to afford a sensible precipitate of light flocculent particles, after considerable repose. With the evidence of these facts before us, we can have no hesitation in stating our opinion that this method of protecting iron from rust will prove of infinite service in a variety

of arts, and will admit of economical application in numerous ways, as the roofing of buildings, sheathing and bolting of ships, and a thousand other forms, and entirely supersede the employment of tinned iron, except in vessels used for culinary purposes, in which, we fear, it could not safely be adopted. It is possible that the objection to the use of H. Davy's protected copper for the sheathing of ships, may also prevail against the employment of the galvanized iron for the same purpose,—the increased tendency to foulness from the adherence of barnacles, weeds, &c., to the ship's bottom; at the same time we think it probable that it may not be liable to that drawback; but this question must be referred to the only satisfactory solution—*experiment.*

J. G. Children,
A. Garden.

London, 17th April, 1838.

By William Thomas Brande, Esq., F. R. S.

Royal Mint, 26th April, 1838.

Gentlemen—I have examined the several articles sent to me by your order, under the name of *galvanized iron,* and represented as manufactured of iron in various combinations with zinc. In this way an arrangement susceptible of electric excitation is obtained, in which, consistently with the laws of electro-chemical action, a preservative power is conferred by the zinc upon the other metal; for in all cases in which two different metals are in contact, a current of electricity may be established in them in such a direction as to protect the least oxydizable of the two metals.

In common tin-plate, or tinned iron, the combination is such that the oxydizement, or corrosion, of the iron is accelerated by the tin, so that the *iron* is the *protecting* and the *tin* the *protected* metal; but in the case before us, in which the respective metals are iron and zinc, the reverse effect ensues, the *iron* is here the *protected* metal, and *zinc* the *protector;* and, consequently, when these latter combinations are subjected to the action of water and other agents, the iron is preserved from corrosion so long as any zinc remains to maintain the electrical current.

I have subjected pieces of this prepared iron to the action of distilled water, to rain water, to sea water, to the joint action of air and water, to dilute solutions of sulphuric, nitric, and muriatic acids, and to other oxydizing or corroding agents upon the common tinned plate and upon wrought and cast iron, and, as was expected, the rusting and corrosion of the iron, is in all these cases entirely prevented in the zinced, or patent, plate; whereas, on the other hand, it goes on with more or less rapidity in regard to the unprotected, and the tinned, iron; and as respects the latter, the iron, whenever it is exposed, appears to be more rapidly corroded in consequence of the adjacent tin.

As far, therefore, as under these circumstances the relative durability of the patent iron as compared with either wrought, or cast iron, or with tinned iron, is concerned, permanence is excessively in favour of the former; and there can be no doubt of the great advantage that must accrue in a vast number of the ordinary applications and uses of these substances, in the employment of the zinced, or patent, plate, and in its substitution for any of the usual forms of manufactured iron.

As my experiments have necessarily been limited in regard to time, I cannot speak with certainty as to effects which may possibly ensue from the pro-

tracted action of chemical agents upon the zinced iron; but both theory and experience lead me to believe that so long as the zinc endures, the protection will hold good.

Again, speaking theoretically, I should presume that the zinced plate, or the other forms of the protected iron, would be admirably adapted for roofing materials, gutters, water pipes, chimney tops, packing cases, and all analogous applications in which a light and durable material that will resist the joint action of air and water is required; that it would also be well adapted for certain tanks and cisterns; for the manufacture of a great variety of articles required to endure a damp atmosphere, such as locks, keys, hinges, and so forth; for cellars, warehouses, and all exposed situations; and for the iron-work of bridges, canal locks, and of much other machinery; for the beams and columns of buildings; for clamps, bars, rails, bolts, nails, screws and nuts; for all out-door works; and for many implements in, and parts of chemical and other manufactories. In short these applications are as obvious as they are endless.

On the whole, I regard this as by far the most valuable practical application of the electro-chemical principle of the protection of metals which has hitherto been carried into effect.

I am, Gentlemen,
Your faithful servant,
William Thomas Brande.

In addition to which indubitable opinions, the following translated extracts from the French Society are corroborative and interesting.

"Chemists have long attempted to apply electricity by perpetual contact to the preservation of iron; but the means employed were defective and unsuccessful, until the recent discovery by M. Sorel. Sir H. Davy died with the conviction, that the application of the principle was possible, and would some day be attained.

"Science has already given testimony in favour of M. Sorel's process. Messrs. Dulong and Dumas have frequently alluded to it in their addresses to L'Academie des Sciences.

"The following extract is from a Report made to the General Meeting of La Société d'Encouragement, at which Baron Thenard presided on the 5th July, 1837.

"'The experiments of several members of the Committee of the Chemical Arts have proved that M. Sorel's process effectually protects iron from oxydation. It is, therefore, to be expected, that the galvanic coating will soon be applied not only to the sheet-iron but to many of the larger masses of that metal, cast or wrought, which are employed in naval architecture, military implements, and domestic buildings, especially to the iron-work of shipping exposed to the atmosphere, or to salt water; to war projectiles, to masses of iron buried in damp situations, or covered with plaster.

"'The Galvanic Paint is well adapted to all articles of iron exposed to the action of air or water, or both alternately.'"

Extract from the Report of L'Academie des Sciences. Paris, 11th April, 1837.

"M. Dumas read a Report, by which it appeared that various trials had been made by Sir H. Davy and other chemists to preserve iron from rust, but that none had succeeded. He at the same time read a

letter from Captain Born, (of the Artillery of France,) addressed to the Academy, calling their attention to the vast importance of this discovery in its applicability to military purposes only. In giving the substance of Captain Born's letter, M. Dumas said, 'the military and naval artillery had a stock of 7,734,000 projectiles of the value of 26,000,000 francs (1,100,000*l.* sterling.) According to Captain Born's estimate a pile of cannon balls, after twenty years' exposure to the open air, are almost all unfit for service. If it be admitted, as it must be, that the value of a projectile, sold as cast iron, is not more than one-third of its cost price, then is the importance of this discovery apparent. Supposing that the Government of France should adopt M. Sorel's process the expense of which is very trifling, it then would appear, from Captain Born's calculations, that a saving of 17,333,334 francs, for this part alone of the war department, would accrue in twenty years.' "

The Patent Process may be applied in three different ways, all equally simple:—

1. By coating iron with zinc in a fluid state.
2. By applying a paint made from zinc.
3. By covering with a powder made from zinc.

Under the first process, many articles, not already referred to, will occur to every one considering the subject. Gas-pipes, water pipes, rails, for tram-roads, iron bridges, iron boats, roof-gutters, iron railing, interior of steam-engine boilers, iron sheathing of ships, ships' bolts, &c. On the applicability of the patent process to the three last mentioned articles but little, if any, doubt exists in the minds of our most eminent chemists. The difference in the cost of a seventy-four gun ship between iron and copper would be as 810*l.* to 6480*l.* The saving in her Majesty's Navy and in the Mercantile marine of this country would consequently be enormous.

Under the second process, zinc paint would be employed wherever the bulk of the article to be protected or the difficulty of displacing it would render an immersion of the iron into the heated metal impracticable. Bridges, therefore, already constructed, boats already built, in short all articles already fixed may be preserved from further decay by the use of the patent paint. This paint will not be dearer than white lead.

By means of the third process, the finer sorts of iron and steel will be preserved. All articles of hardware and cutlery are subject to the most serious deterioration by exposure to moisture; but by applying to them the galvanic powder, or wrapping them in paper prepared with it, they may be exposed with safety to any weather, or exported with security to any climate.

It remains only to repeat that the processes are not expensive. However numerous and important are the admitted advantages of these discoveries, they would be less striking were they to be obtained only at a high price. The process of coating with the metal in a liquid state is cheaper than tinning. Tin is worth 98s. per cwt., zinc 20s. per cwt. Supposing that galvanized sheet iron should be sold at the price of tinplate, the profit would be, at least, 100 per cent. Lond. Mech. Mag.

Blasting by Galvanism.

Mr. Bethell, who for many years past has been engaged in inquiries and experiments on diving, and is the patentee of an improved diving dress, favoured the Institution* on the following meeting, April 24, with the result of his practical experience of the effects of a blast ignited by galvanism. This he had been led to devise by having frequent occasion to blow off the decks of sunken vessels, in order to enable the divers to reach the cargo. We will first describe the usual mode of conducting this operation, which is as follows. The charge of powder is enclosed in a tin canister, and deposited in a requisite position in the wreck. It is lighted by means of a sort of quick match, made of cotton steeped in spirits of wine and gunpowder, and then dried. This match is protected from the sea water by an Indian rubber tube enclosing it, and inserted, water-tight, into the canister. These precautions being carefully taken, the fire is conveyed with tolerable certainty to the charge; but as it runs along, it, of course, blows up the India rubber tube—a very expensive process when the depth of water is considerable.

We will now proceed to describe Mr. Bethell's mode of effecting the same object: we could have wished to illustrate it by a sketch, but are unavoidably prevented by want of time. We will, however, undertake to render the matter clear to any one who has ever seen a galvanic battery in action—perhaps to some others besides. It is well known that a piece of platinum, or of iron wire, when made to connect two copper wires leading from the two poles of the battery, instantly becomes red hot, and capable of igniting gunpowder, or even lighting a spirit lamp. The problem for Mr. Bethell to solve, was just this; to introduce this same piece of platinum, or iron wire into his charge of powder, and keep open, when placed in its situation under water, its connexion with his galvanic apparatus in his boat above. This object he effected as follows:—To consider first his canister; in the top is fixed a cork coated with sealing wax, through which descend, water-tight, two vertical copper wires reaching into the middle of the charge. These are separate during their whole course, except at bottom, where they are connected by a piece of platinum, or of iron, wire; and at top they rise a little way above the cork, and are curled round into two distinct loops. After the charge is introduced, the top is cemented on the canister with putty. This then being all ready for the explosion, let us consider, secondly, Mr. Bethell's chain of communication. Now, here the difficulty is, that we must have not only two wires, but two wires insulated, kept totally distinct as far as their power of communicating the galvanic action is concerned; for this action is wanted in the canister, not in the boat, nor in the sea water. For this purpose Mr. Bethell coats the wires with a non-conductor; the best he considers to be the caoutchouc solution, or varnish, prepared by Macintosh and others. His wire is about as thick as common bell wire, and wrapped round with cotton thread, like the wire which the ladies use for millinery. Two of these cottoned wires are coated with the varnish; when dry they are connected together by thread, and form a galvanic rope, which may be laid by for use, in coils of any necessary length. The wires in the canister are likewise separately covered with cotton, and coated with the varnish; except at the two ends, at the one end of which

*Inst. of Civil Engineers.

they touch the platinum connecting wire, and at the other the galvanic rope leading from the boat.

And now, his apparatus being ready, Mr. Bethell proceeds to his operations. He has in his boat his galvanic apparatus, coils of rope ready prepared, and canisters ready charged. He takes out a coil; untwists the end for a short distance, removing also the cotton and varnish; he then twists the ends of the two wires, one into each of the loops projecting out of the canister top. The ends of the wires and the loops, both of which we have stated to be without varnish, are then coated separately with sealing wax—a non-conductor likewise. Thus Mr. Bethell obtains what he wants; a double chain of communication, properly insulated, from his boat to his charge of powder in the canister. He has then only to send down a diver to lodge the canister in its proper place, letting out the galvanic rope as he descends; and on the return of the man all is ready. The two wires are separated at the end of the rope in Mr. Bethell's hands; he brings one into connexion with each pole of the galvanic apparatus: the galvanic fluid finds an unbroken chain of communication down to the platinum wire in the canister: quick as thought the platinum grows red hot, and the explosion takes place as was desired.

Repeated experience has proved the efficiency of Mr. Bethell's contrivance. He has used a battery of six cells, and has found it sufficiently powerful for his purpose when using a galvanic rope of 100 yards. But so long a rope is seldom necessary in practice; for a charge of two or three pounds of blasting powder is found to produce no other effect than a wave on the surface, when exploded thirty feet under water. Mr. Bethell states, however, that one of Professor Daniel's six-cell batteries will ignite a charge at the distance of 300 or 400 yards. This would insure the safety of the operator in most cases where danger arises from the common modes of blasting; and with more powerful batteries, the effect might be produced at much greater distances—miles off, says Professor Daniel. The same method is, of course, applicable to the blasting of rocks under water, an operation frequently necessary in the construction and improvement of harbours, and in other marine works. For these purposes, also, Mr. Bethell's improved diver's dress, before alluded to, will be found of great service.

The economy of Mr. Bethell's process is very great. In all cases, the canister is, of course, blown up: by that which we have been describing, instead of an India rubber tube reaching from the boat to the charge, there is destroyed only about six inches of the galvanic rope—about a foot of common copper bell wire saves, shall we say fifty yards of India rubber tube?

Mr. Bethell's improved process is plainly capable of application to all cases where blasting is used. In military engineering, for example, it offers the grand advantage of enabling the officer himself, in safety and at a distance, to apply the match (as he would say) to a number of mines almost simultaneously, and blow up the enemy with the utmost precision. A galvanic battery indeed would at first amuse both officers and men; but as the novelty wore off, it would take its place among the paraphernalia of war, and make itself respected. It is the frequent fate of useful inventions to be first laughed at, then tried, then used—and, last of all—praised.

We confess, however, that we have always far greater pleasure in witnessing the application of new discoveries in science and ingenious inventions in the arts, to the pursuits of peace, than to the deeds of war. Man ever appears in the noblest light when employing his intellectual endowments in directing the powers of Nature rather to the preservation than the de-

struction of life. And we do hope that great good will arise from the application of Mr. Bethell's process of blasting to the purposes of mining. Lay in a mine as many blasts as you please—you may then call off all your miners and place them out of reach of danger, and explode the whole at once. The superintendent of the mine in his office, or the proprietor in his parlour, may fire all the blasts—the miner may lay the charge; but let him try to light the copper wire as long as he pleases—the platinum remains cold till the galvanic fluid darts into it and fires up the explosion at once.*

Min. Rev.

Signor Pistrucci's new method of striking up Medals without the aid of engraving. By Wm. Baddeley.

Signor Pistrucci's first application of his new process, has been in striking up a seal for the Duchy of Lancaster. This seal is four inches in diameter, of sterling silver; one side presents a very beautiful equestrian figure of her Majesty, Queen Victoria, surrounded by a bold inscription; on the reverse, the arms of the Duchy are richly emblazoned, in the midst of a profusion of scroll-work, with an inscription. To have *engraved* the two dies for striking up this seal, would have taken about fourteen or fifteen months hard labour, with the risk at the end of that time, of the dies breaking in the process of hardening. By Signor Pistrucci's method, they have been produced in less than fifteen days.

There is an exquisite softness, and a boldness of relief, in many parts of this seal not attainable in an *engraved* die; the graceful flowing of the drapery, the prominence of the arm of her Majesty, as well as the ear and hoofs of the horse, are altogether unrivalled. The fame of Signor Pistrucci's success has drawn to the Mint, most of those who are celebrated for their practical acquaintance with the powers and properties of the metals, and with mechanics generally; one and all of whom have expressed themselves astounded at the results obtained. When such gentlemen as Bramah, Maudslay and others, state, that nothing short of seeing with their own eyes would have satisfied them of the possibility of such a work, incredulity may well be pardoned in those who have not witnessed the recent production. There are plenty of workmen in the Royal Mint, well versed in all the methods employed at the *Soho* for the last fifty years, and they all agreed in designating Mr. Pistrucci's plan, when first propounded to them,—as a *new fangled and impossible scheme,* and yet have these very workmen themselves since proved its *possibility.*

The outline of Signor Pistrucci's plan, is tolerably well explained, in the *Times* newspaper; the subject is modeled in the usual way, either in wax, clay, or other fit material, from which a cast is taken in plaster of Paris. The plaster cast being hardened, is moulded in fine sand with great care, and a cast, in iron, is taken from it. The great *secret*—if there can be any secret in what has been published in the leading journal of the day, and thence very extensively copied into other publications—consists in the *thinness* of the *iron castings.* The plaster of Paris

* See Jour. Frank. Inst., vol XII, page 221, (Oct. 1833,) for a paper by Dr. Hare, in which the same mode of blasting by galvanic ignition, is suggested and described. The practical part of the operation as recommended by Mr. Bethell, is perhaps more simple and effectual—the result of frequent trial and experiment—but the principle is the same. G.

model is left only about one eighth of an inch thick, the consequence of which is, that the *chill* which takes place on the *surface* of all iron castings, from the proximity of the two surfaces in this instance, pervades the whole mass, giving it the hardness of a hardened steel die, with a toughness, not attainable by the latter metal while in a hard state.

In all large castings, the contraction of the mass of metal in cooling causes a shrinking of all the finer lines, while in thin casting, the sharpness of every line is preserved with surprising beauty.

The iron casting having been made perfectly flat at the back, a hollow is turned out in a steel bed to receive it, and when thus mounted it is ready for use. One proof among many others, of the extreme hardness of the cast iron dies, is afforded by the fact, that no extension of the metal takes place from the severest blows: the die fitting no tighter into its bed after striking up a medal, than it did before. The seal before alluded to, took upwards of one hundred and fifty blows from the most powerful press in the mint, and the dies appear in every respect as perfect now as when first cast.

Many persons, who, from their known celebrity and eminence in the scientific world, would be considered the very highest authorities that could be cited in a question of this kind, have not only on examination admitted the *entire novelty* and great importance of this process, but have charged Signor Pistrucci with injustice to himself, for neglecting to secure the privileges of a patent. This, however, the Signor has from the first declined to do; choosing rather to throw open the result of his (miscalled) "hours of idleness," for universal public benefit.

What the real value of this discovery is—or where the useful application of the fact thus established will stop, it is at present wholly impossible to imagine. The advantages of being able to produce at so little cost, and in so short a space of time, the most perfect and beautiful designs—or to copy with so much facility the choicest productions of others, are altogether incalculable. One drawback, perhaps, is the power thus placed in the hands of the fraudulent copyist, and the spurious coiner; but the knowledge of an existing power to do certain mischiefs generally produces an antidote sufficient for the evil, and it is to be hoped the present case forms no exception to the rule. One happy effect of the general introduction of this method of obtaining *dies*, will be, to make the *die-sinkers* more of *artists* and less of *mechanics*, to wield the graver *less*—but the pencil *more skilfully*. Should my endeavours to render this useful process intelligible, not be sufficiently explicit, I shall have much pleasure in affording any additional information that may be thought necessary.

Lond. Mech. Mag.

Simple Letter Copying Machine. By N. S. Heineken.

The object of this contrivance is to afford to the traveller a portable instrument for copying letters, &c. It consists simply of a brass tube 14 inches long and 1½ diameter. One end, which has a bottom soldered into it and a cover fitted to it, contains a small bottle of copying ink. To the inside of the cover of the other end is attached a brush for the purpose of damping the paper. The space between is occupied by sheets of copying paper, together with some oiled paper and thick blotting, or filtering, paper

in a cover. To use the instrument it is only necessary to place a sheet of copying paper between the leaves of blotting paper, which have been previously wetted with the brush, and to let it remain till sufficiently damp —or, more expeditiously, to damp the copying paper itself with the brush and allow the dry blotting paper to absorb the superfluous moisture. Place the paper thus prepared upon the letter, &c., and over it a piece of oiled paper and roll the whole tightly upon the outside of the brass tube which may be then rolled under the hands upon a table; a copy may thus be readily taken off. The tube also serves the purpose of a ruler.

Lond. Mech. Mag.

Manufacture of Salt for Dairy Purposes.

The Dutch are remarkably particular as to the proper quantity and quality of their salt, of which there are three kinds manufactured. The small salt for butter, which is somewhat smaller than the common salt made in this country, is boiled, or evaporated, in 24 hours. This kind is also used, as already mentioned, in mixing in some districts with the Kanter cheese. The second salt is evaporated by a slower process, in about three days. It is used in salting by outward application, the Edam, Gouda, and in some places, the Kanter, cheeses. This kind is beautifully formed in natural crystals of about half an inch square. The third kind is larger sized; the crystals are nearly an inch square, and the evaporation process lasts four or five days. It is sometimes used for salting the cheeses by outward application, but principally for curing fish, beef, pork, &c. The Dutch pay great attention to the exact quantity of the particular kind of salt necessary, so that we never find the cheeses made in Holland salted to an intolerable degree, as we sometimes experience in this country. I (says Mr. Mitchell) endeavored to discover the mode of manufacture, and learned some particulars on this important subject, but there appeared to be some secret in the process, which the manufacturers were unwilling to disclose. One thing is certain, that the use of the Dutch salt is one of the causes of the sweet and delicious flavour of their butter, which, although always well flavored, hardly tastes of salt, or rather of that acrid quality which the poisonous bittern of the muriate and sulphate of magnesia, pervading our common salt, imparts to our butter; and this is very obvious in comparing the Dutch butter with the best salted butter of this country. When it is considered that the health and prosperity of the people are materially concerned in the use of this article in so many various ways, the propriety, or rather necessity, of improvement in its manufacture will be more evident, and it is rather remarkable that whilst chemistry has now advanced to such perfection, no change has taken place in the mode of making salt for several centuries. The late scientific Earl of Dundonald, the late Dr. Coventry, and the Rev. James Headrick, proposed important improvements in the mode of manufacturing this article, which, however, seem never to have been adopted.—*Times.*

London Mechanics' Magazine.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

Report made to the Academy of Sciences, on the Filtering Apparatus of Henry de Fonvielle. By M. Arago.

The Academy has charged M. M. Gay Lussac, Magendie. Robiquet and myself, with an examination of the filtering apparatus of M. Henri de Fonvielle. The question of filtration is so important and so keenly agitated at the present time, that high authorities, the municipal administration of our chief cities, as well as private individuals frequently consult the Academy on this subject, so that it has appeared to us to be proper to consider the problem in all its bearings. It is, besides, the best mode of suitably appreciating the new method on which we are appointed to decide.

Mankind use for drink, for cooking, for cleanliness, and for the useful arts, cistern water, well water, spring water, and river water. These four kinds of water have one common origin—rain. Rain water is, in general, so pure, that foreign matters can be detected in it, only by means of very delicate chemical reagents.

Cisterns, constructed with well chosen materials, would therefore be the best means of obtaining excellent water for drinking if the rain all fell directly into them, and did not bring with it dirt, dust, insects, accumulated in dry weather on the roofs and terraces over which it flows. In certain localities, as at Venice, for example, the inconveniences now alluded to are felt to such an extent, that they found the necessity of causing the rain water, before it reached the great cistern of the Ducal Palace, which was much resorted to by the public, to pass through a thick bed of porous materials, in the interstices of which the foreign matters held in suspension might be in part deposited.

Wells may be compared to cisterns, only they are not supplied by channels of brickwork, stone or metal. The water of the clouds reaches them, if we may so speak, drop by drop, through the common, capillary openings of the soil. It is rare that in this long and difficult trickling in fine streams, the water does not meet with soluble materials, which it dissolves in greater or less quantity. It is not therefore strictly speaking, rain water that we draw from our wells: it is generally as clear and limpid, but it contains, almost always, matters dissolved, whose chemical nature varies with the geological constitution of the country.

The same remarks are applicable to springs. The water which they distribute is also rain water, which, having passed through more or less of the crust of the earth, is returned to the surface by a siphon stream, or in other words, by pressure through streamlets of water from a more elevated situation. The nature and the proportion of foreign matters in spring water depend also on the extent of the streamlets which feed the source and the nature of the rocks through which they percolate. When these rocks are of a certain kind, the country will abound in mineral springs. If the vertical descent of the fluid is of a certain extent, the water will issue in a thermal (warm or hot) spring.

Every river bears to the sea, the waters of some principal spring, and those of a certain number of others, of minor importance, which unite with the main one in its passage. In chemical composition the water of a river might thus seem to be a medium between those of all the springs of the

surrounding country; but it must be observed, that at the time of freshets or heavy rains, (and if the valley of the river be extensive, these may occur very often) the fluvial waters do not sink into the earth in large proportions, but flow over its surface in great abundance and with great rapidity; and that in this superficial flow they can dissolve but a very small portion of foreign matter, compared with that which they will take up when divided into minute streams, and pursuing an underground course, during which the particles are so constantly in contact with soluble materials. To these considerations in favour of the purity of river water, must be added the fact that carbonate of lime is dissolved by aid of an excess of acid, and that this excess is dissipated during a long exposure of water to the air, in consequence of which the carbonate itself is precipitated.

These remarks, moreover, are to be considered only in a general point of view. It would not be difficult, in fact, without departing from the known laws of Geology, to imagine, and even to find arrangements of strata, whose wells and springs would furnish pure water, while the neighbouring rivers on the contrary, might contain a strong saline impregnation. All that we aim at is to explain how the reverse of this generally takes place,—how the water of the Seine and of the Garonne, for example, are notoriously purer than the waters of most of the springs and wells of the countries through which these rivers respectively flow.

But the advantage of greater purity in river water, chemically considered, is more than lost by their habitual want of limpidity. At each heavy rain, the little torrents are precipitated into the stream, loaded with vegetable soil, clay, gravel and all sorts of detritus which they tear up from the land, and these heterogeneous ingredients are driven along until they are gradually deposited in the river's bed.

The proportions of these foreign mixtures held in suspension during freshets, are not the same in different rivers, as might well be expected. In the Seine, this proportion rises sometimes to $\frac{1}{2000}$. He, therefore, who should drink in the course of his day's work, three quarts of the unfiltered water of the river, at the time of its highest flow, would load his stomach with more than a scruple of sand and mud. What effect, must not this, in time, produce upon his health? The question has been much discussed and it has left physicians and hydraulic engineers, very much divided in opinion. For want of exact experiments, both parties agree to leave the question where they found it. We shall certainly not be considered too severe in our judgments, if we add that one of the declared partizans of these troubled waters, rests his opinion on the alleged observation, that animals, cattle especially, do not begin to drink from the pools which they meet on the way, until they have well stirred up the mud with their feet!

But, every consideration of health aside, it is certainly very disagreeable to drink water charged with dirt. At all times and in all countries, limpidity has been regarded as a necessary quality of the water destined for human beverage; and on this account, long before the invention, or at least the perfection of the means of filtration, the ancients deemed it necessary to dig deep wells, at great expense, or to bring in by magnificent aqueducts, the water of natural springs, even when their towns were situated on ample rivers.

It is by its rapid motion through, or over, the ground, that water becomes loaded with mud. By repose, this is precipitated and the fluid resumes its natural transparency. Nothing is certainly more simple, than this mode of clarification; it is unhappily excessively slow.

From the very interesting experiments and calculations made at Bourdeaux, by M. Leupold, we learn that after 10 days of absolute repose, the water of the Garonne, taken at the time of a freshet, had not returned to its natural limpidity. At the commencement, it is true, the larger particles subside very fast, but the finer go down with a slowness which would put all patience at a stand.

Simple repose then cannot be resorted to as the means of clarifying the water destined for the supply of a large city. Who does not perceive that 8 or 10 separate basins would be necessary, each of sufficient capacity to contain all the water necessary for a day's consumption? Add to this tha in certain places and at certain seasons, water exposed in a stagnant condition to the open air during 10 consecutive days, would become foul and taste badly, either on account of the putrefaction of innumerable insects which would fall into it from the atmosphere, or in consequence of the vegetation which would begin to take place on its surface.

Repose, however, may be considered as one valuable means of getting clear of the grosser particles which are held in suspension. It is under this point of view *only*, that basins and reservoirs have been contrived and established in England and France*.

Science, or rather chance, brought to light the means of hastening considably, or rendering almost instantaneous, the precipitation of earthy matters held in suspension by water. This means consists in adding powdered alum to the turbid water. It is averred that at Paris, the gross slime brought down by the Seine, collects into long thick strings which are very promptly deposited when alum is added. The theory of this operation ought to claim the attention of chemists. It is not at present sufficiently certain, to justify us in affirming, that the same effect would take place in the sediment of every river. Some doubt seems admissible from the fact that the clarification by alum is not always complete; that certain very fine particles escape the action of this salt, remain in suspension, and render the liquid somewhat cloudy (louche) when all the stringy portions have disappeared. If it is true that water after having been alum'd, still requires filtration, we can easily conceive why the employment of alum, as a means of clarification, has not become general. Besides, in the large way, the price of the salt in addition to other means, might be objectionable. Another more serious objection is that it affects the chemical purity of river water, that it introduces a salt which it did not before contain,—that in supposing this salt wholly inactive in certain proportions, consumers might fear that at times these proportions might be very materially exceeded, and that this might easily happen through the negligence, or mistake, of a workman. One of the committee (the reporter) was speaking one day of the aluming of water to an English Engineer, whose extensive experience had given him much practical acquaintance with the habits and feelings of the public, and who was lamenting the imperfection of the means now in use for purifying water,—"what are you proposing!" said he immediately: "water, like Cesar's wife, ought to be beyond all suspicion."

This, in terms perhaps singular, but true, is a pointed condemnation, of every means of clarification which would introduce into river water any new substance, that it does not originally contain; and therefore the

*The author appears to forget that reservoirs are indispensable, as the means of insuring a regular supply when the water has to be forced to a greater height, by means of machinery, in order to bring it to the requisite hydrostatic elevation, as in the water works of Philadelphia, Wilmington, &c. TRANS.

most recent trials of engineers have all been directed to the employment of inert materials, or those which cannot add any thing to the water. These materials are gravel of different sizes,—sand of different degrees of fineness and pounded charcoal.

The idea of applying gravel and sand to the clarification of turbid waters was certainly suggested by observing so many natural springs issuing from sandy bottoms with remarkable limpidity; hence the practice is very ancient, and hence do we ascertain it to have been in vogue, in the Ducal Palace at Venice. A bed of fine sand appears to act, in the clearing of water only as a mass of sinuous capillary tubes, through which the liquid molecules may pass while the earthy matters in suspension are arrested, in consequence, simply, of their greater dimensions.

From the experiments of Lowitz, Berthollet, Saussure, Figuier, M. M. Bussy, Payen, and some other chemists, it is now known by almost every body, that charcoal has the property of absorbing the matters resulting from the putrefaction of organic bodies. The part which charcoal acts therefore in the purification of water cannot be doubtful.

Theoretically considered, the art of the clarifier, appears to be nearly complete; but this is very far from being the case with respect to its economical and successful application, especially when the object is to conduct the operations on a great scale.

Very extensive filtering apparatus has been put into operation by our neighbours on the other side of the water, and especially at Glasgow. The cost of these essays must be counted by millions (of Francs.) Nevertheless they have not been successful, but on the contrary, they have occasioned the ruin of several powerful companies.

Those who are engaged in the amelioration and extension of the useful arts, may certainly find excellent guides in natural phenomena, but on the express condition that they do not allow themselves to be seduced by imperfect similitudes. Such has been, we venture to affirm, the principal origin of the errors committed in Scotland. Certain springs, it was said, flow uniformly without interruption; they have for ages furnished the same quantity of transparent water; why should not the same result follow from an artificial fountain, under analogous circumstances. But, in the first place, is it certain that these natural springs, of which so much account is made, have experienced no diminution? where are the wooden conduits by which they have been measured? who has compared their issues, cautiously, year by year, with the quantity of rain which has fallen? Moreover, (and herein it is that the Scotch engineers have particularly erred) in an artificial fountain, the filtering strata must always be of limited extent, while the waters of a natural spring are clarified, sometimes, by beds of sand which spread over whole districts, and which act upon a fluid which is but little troubled. In the first case, the capillary tubes of the filter will soon become foul; while in the second, the effect will scarcely be visible.

The result is, that no artificial method of filtration can be successful, unless prompt, economical and certain means are at hand, of cleaning or renewing the filters. Only one of eight large companies in London, that clarify the water, viz. the Chelsea company, has attained its object. This has been done by the construction of three large basins communicating with each other; in the first two, the coarser terrene particles are deposited by repose; in the third, the water traverses a thick bed of sand and gravel whereby it becomes definitively purified. When this basin is empty, the fil-

trating mass of sand is exposed, at which time, workmen immediately remove by rakes the superficial layers which the sediment has rendered foul, and replace it by fresh sand.

A thought here suggests itself. It is not certainly, without a good reason that the able engineer of the company has made his filtering bed 6 feet thick;—the superficial layers, which the workmen remove from time to time, act without doubt more effectively than the others; but those below, must nevertheless have some influence, and must also by degrees become engorged with the matter arrested, daily become less efficient, and in time the whole must require to be changed. The necessity of this, when anticipated, would require the agency of a fourth basin, like the third, and like it of the extent of an acre of ground. The total expenditure in these works has amounted, to from 300,000 to 400,000 francs; and the manipulations of the filter, which cost annually not less than 25,000 francs, must be continually increasing.

Is it surprising, that in the view of such heavy expenses, encountered by the Chelsea Company for the filtration of 10,000 cubic metres of water per diem, corresponding to about 500 square inches of main pipe, the other English companies, should all, in an examination before parliament, declare that if compelled to filter the water of the Thames, their rental prices would have to be raised 15 per cent.

The system which Robert Thom, a civil engineer at Greenwich, introduced in 1828, has the advantage over that at Chelsea, of a self-cleaning operation, to which the whole filtering mass is subjected. This mass forms a bed 5 feet thick. The water is admitted into the basin, filled with sand, either above or below, at pleasure. If the filtration, for example, is by descension, as soon as it is perceived that the filter is obstructed and becomes effete, the water is, for a while, introduced below, and in its ascensional movement it drives the sediment from the upper surface into a discharging pipe destined to receive it.

Filtration, has not, hitherto, been attempted in France on a very large scale. In several valuable establishments in Paris, at which it is performed, a large number of small boxes, lined with lead, open at top, are provided, and contain at bottom a bed of charcoal between two layers of sand. These are, in fact, the old filters patented by Smith, Cochet, and Montfort. When the waters of the Seine and Marne, arrive at Paris, very highly charged with silt and undergo depuration in those boxes, it is found necessary to renew the strata, or at least the upper one, every day, and even twice a day.

Each superficial metre of filter gives about 3000 litres, (nearly 800 gallons) of clarified water every twenty-four hours; hence it would require 7 square metres, or 7 cubic boxes of one metre in the side, for every inch of fountain pipe, and 7000 such boxes would be requisite for the service of a town, where the consumption would demand 1000 inches.

There is a very simple method of increasing the product of these little boxes; it is to close them hermetically, and to cause the water to pass through the filtering mass, not by its own weight merely, or by a simple charge, but by strong pressure.

This, gentlemen, is one of the improvements in the filtration of water, which is proposed, and which has been realized, by the author of the memoir committed to our examination.

The filtre of Henry de Fonvielle, at the Hotel-Dieu, though it has not one metre of superficial extent, yields daily, by a pressure of 88 centimetres,

(= 34.6 inches of mercurial pressure, = 1¼ atmospheres.) 50.000 litres, (= 13,200 gallons,) at least, of clarified water. This amount, deduced from an examination of the various services of the Hospital, is a small part of what the apparatus might furnish if the feeding pump were constantly in operation. At certain times we found, in fact, by direct experiment, that the filter would yield as much as 95 litres, (= 24 gallons,) per minute. This would be nearly 137,000 litres in 24 hours, equal to about 7 inches of pipe. But the quantity first named is 17 times greater than by the methods commonly in use.

Since M. de Fonvielle presented his memoir, and especially since the results at the Hospital, several persons, and among others M. Ducommun, have claimed the invention of filtering by increased pressure. In mathematical strictness these claims might perhaps be sustained; for to a greater or less extent, it is unquestionable that in every machine existing, or known only by patent, and particularly those that filter by ascension, there is a pressure, it may be of some inches; but, regarded in a practical point of view, the question is a very different one. It is whether any one, before the author of the memoir, proposed to effect the filtration of water in vessels *hermetically closed*, allowing nothing to escape, from the pressures which the locality or the machine can produce; whether any one, prior to de Fonvielle, had arranged a filtering apparatus in such a manner that *strong* or high pressure would not derange or confuse the different layers;—whether in fact, any one before the experiments at the Hospital, had proved that a rapid filtration would give a fluid so limpid as to be perfectly satisfactory. In all these respects the rights of M. de Fonvielle appear to us to be incontestable. From the parliamentary enquiry before alluded to, we learn that engineers had not been unmindful of the possibility of effecting filtration under moderate pressure,—and that some had adopted this mode in a manner which involved them in hydraulic errors. In France we find every where, and especially at the beautiful mineral water establishment at Gros-Caillou, a fine disposable high pressure, entirely neglected. We see in fact, M. Ducommun, whose name is so honorably known in this department of the arts, using at the Hotel-Dieu, three cisterns to clarify 15 hectolitres in 24 hours, while a single one of these cisterns, modified by de Fonvielle, yields in the same time, agreeably to the report of M. Desportes, steward of the Hospital, 900 hectolitres of water, perfectly filtered, in lieu of the 15.

But the employment of high pressure is practicable only in combination with another process of which no one contests the invention with the author of the memoir.

We have seen, in time of freshets, a filter of one square metre, requiring to be cleansed once at least in 24 hours, although it would clarify only 3000 litres of water. It would seem, at the first view, that the filter of M. de Fonvielle which clears 17 times more, must require cleaning every hour. Such however, is not at all the case. No more attention is requisite than in ordinary filters.

The explanation is simple enough when we remark that under a feeble pressure, a filter acts as it were, only at its surface,—that the mud scarcely penetrates it, while, under great pressure it may, or must, sink deeper. No one will deny that if more turbid water passes in a given time, there must be a proportional deposition of feculent matter, but if this be found disseminated through a greater depth of sand, the permeability of the filter, will not be more changed by it,—the cleaning merely will be more difficult;

it is in this respect, above all others, that the new process is worthy of attention.

We have already stated that at Greenock, the engineer, R. Thom, cleans the mass of sand, by a rapid counter current, viz: from bottom to top. This mode may suffice, when the filters are choked only at the surface; but the filters of M. de Fonvielle require more powerful means. This the author finds in the action of two counter currents,—in the shock, and sudden shaking and stirring which result from them. In cleaning the hermetically closed filters of the Hotel-Dieu, the workman, whose business it is, opens suddenly, and almost simultaneously, the cocks of the tubes which connect the bottom and top of the apparatus with the elevated reservoirs, or with the body of the feeding pump. The filter is thus tumultuously agitated by two cross currents, by which it is acted upon in a manner not very unlike that which a garment undergoes in the hands of a washerwoman. These currents, have, in every case, the effect of detaching from the filtrating gravel, the foreign matters which would otherwise remain adhering to it. We have no doubt of the great utility of these conflicting currents; for after having cleaned the filter of the Hotel-Dieu, agreeably to the method of engineer Thom, i. e. by an ascending current, after assuring ourselves that this ascending current came out limpid,—as soon as the two other cocks were opened, the water rushed out from the filter in a very filthy condition.

We may add the passing remark, that the patients who witnessed the operation, expressed their great surprise at seeing, after an interval of a few seconds, the same fountain furnish, first a yellow mass as thick as soup, and then water as clear as crystal.

We may add to these numerous details, that the process which you have charged us to give an account of, has received the sanction of time. For more than 8 months it has been in operation at the Hotel-Dieu; for more than 8 months the same bed of sand, of at least a square metre in surface, has performed its functions without intermission; that there has been no occasion of renewing it; that the Seine, nevertheless, within this period has been extremely foul, and that, at the lowest estimation, 12 millions of litres of water, (12000 cubic metres,) have passed through the apparatus. From these various circumstances we have deemed it unnecessary to make any trials of the further advantages which the author of the memoir expects to derive from a division of the thick filtering body now in use, into three beds, separated from each other; and in confining ourselves exclusively to what we have sufficiently examined, we do not hesitate to say that in showing the possibility of clarifying large quantities of water with a very small apparatus, M. Henry de Fonvielle has made an important advancement in the arts.*

Progress of Civil Engineering.

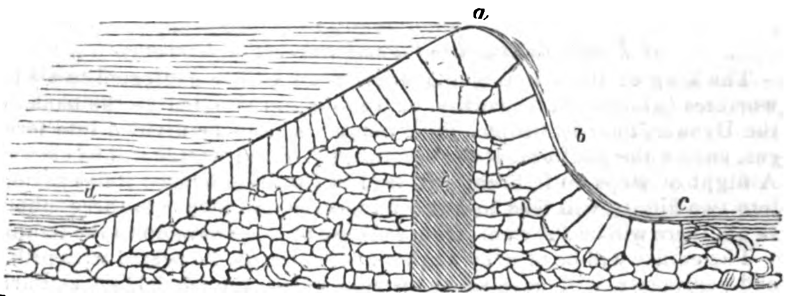
On the most proper sectional Form to be given to Weirs or River Dams.

By Robert Mallet.

The section of weirs or dams, when of masonry, appears, in most

*May we not take the liberty of suggesting the probability, that if the ascending current of water at Fair Mount, were made to pass through a tight box, containing the requisite filtering materials, agreeably to the admirable contrivance of De Fonvielle, it might furnish a simple and unexpensive mode of clarifying the water, of the river, which, at certain seasons, is so turbid as to be almost past endurance. Trans.

instances, to be pretty nearly a rule of thumb business, with the exception of some examples by Mr. Telford. The model of an earth embankment appears to have been adopted for stone ones, with but little care either as to the best position for the stones of the masonry, for maximum strength, or as to the outline that would give the easiest descent for the falling fluid, and, by consequence, the least wear and tear to the structure. Not to encumber your pages with a parade of analysis, I shall just state the results I have arrived at, and leave your mathematical readers, who will at once see what I would be at, to judge for themselves; while the practical man can discern from the figure whether the positions and forms I have assigned to the stones of the masonry are the most suitable. Supposing, then, the plan of the weir to be an arch pointing up the stream; I conceive the line of section, from *d* to *a* in the annexed figure, should either be a right line, or, pos-



sibly, a parabolic segment, presenting a convex inclined surface to the water in very deep streams. The line from *a* to *b*, I consider, should be a parabola, to which the water-level should be a tangent; because this curve gives the easiest change from direct to curvilinear motion, and hence with the least expenditure of force. Lastly, I think the line from *b* to *c* should be a cycloid, as being the curve of quickest descent; so that the combination of these two curves will fulfil the condition of giving the easiest change of motion to the water, from a rectilineal to a curved, and back again to a rectilineal, possible, and hence the minimum wear and tear to the structure; whilst they possess the co-ordinate property of a judicious form to resist the hydrostatic pressure.

I believe a weir thus formed would cause the fluid to descend in every part in an unbroken sheet, and produce little or no ripple below it. I also think the principles of the form are now for the first time stated.

Arch. Mag.

Canal parallel to the Banks of the Rhine, from Basle to Strasburg.

M. Fourneyron has communicated to the Academy the project for a railroad, with a parallel and navigable canal, from Basle to Strasburg, by Mulhouse, Colmar, &c. It has been found, that, at low water, the waters of the Rhine, in their passage from Basle to Strasburg, have a force of from 400,000 to 500,000 horse-power. The project in question consists in collecting a very small part of this power, by means of a lateral canal, upon which 100 mètres, (325 ft.) of elevation will be divid-

ed into thirty falls, from Mulhouse to Strasburg. On this line a total force of 40,000 horse power will be obtained, which will produce an annual revenue of about 40,000,000 of francs. Alsace is now covered with steam engines, for which fuel is procured at about 80 or 100 leagues' distance. The expense of a steam engine is reckoned at 1200 or 1500 francs for each horse power, by the year; and it is believed that by the projected canal this same power might be produced for 200 francs per annum.

It is also proposed to form a railroad between Basle and Strasburg, upon which the wagons would be moved by hydraulic power (moteurs); for which purpose it is intended to employ another part of the strength of the waters of the river. The wagons and the diligences on this road would go at the rate of from six to eight leagues an hour.—*L' Echo*, Dec. 13, 1837, p. 207. Arch. Mag.

A Temple dedicated to the eminent men of Germany.

The king of Bavaria is going to erect an edifice dedicated to all the worthies (gloires) of Germany, on a mountain situated on the banks of the Danube, near Ratisbon. The mountain is to be divided into terraces, and on the platform, at the summit, a Grecian temple will be erected. A flight of steps 60 ft. broad will lead to the first terrace; stairs divided into two flights, will lead to a second terrace, and thence to three others. In all, there will be 300 steps, from the base of the mountain to the temple.

The edifice will be of grey marble: the exterior, decorated with pillars and pediments, will have some resemblance to the Madeleine at Paris. The pillars will be 54 in number, and of the same color as the rest of the building. Under the vestibule, will be an entrance 24 ft. high, which will have a bronze door, leading to a gallery 150 ft. long by 50 ft. broad, and nearly the same height. Projecting pilasters (des pilastres mis en saillie) will divide this apartment into three sections; and are intended to break the uniformity. The ceiling of each section will be in the form of a tent, and will be covered with bronze, and perforated for a skylight. Above the cornice, on both sides, a row of red marble panels will contain, in letters of gold, the names of those celebrated men whose portraits have not been obtained. Fourteen giants, representing German warriors, will support the ceiling above the pillars and pilasters.

In the gallery, the busts will be arranged along the walls, on stylobates of grey marble. This gallery will be separated by pillars from a back chamber *(arriere salle)*, executed in imitation of the opisthodome of the Greek temple. A frieze 300 ft. in length will extend along the gallery, on which the most remarkable events of ancient Germany will be sculptured in Carrara marble. The two pediments will present two large historic pages: the one will represent the victory of Arminius over the Romans, and the other the *regeneration* of Germany, after the fall of Napoleon. The figure of these pediments will not be in bas relief: they will be in alto relievo (rondes basses), like the Pantheon at Athens. By this means, they will be rendered visible at a much greater distance.—*L' Echo*, Dec. 13, 1837, p. 201. Ibid.

Mechanics' Register.

Steaming Extraordinary.

Yesterday afternoon, Mr. Walter Hancock, the enterprising steam-carriage engineer, accompanied by two friends, rode from Stratford and through the principal streets of the City in a steam-gig! Mr. Hancock remained a considerable time with this novelty of science in front of Guildhall, now and then guiding it adroitly round the open space. This was about a quarter past four o'clock, when a great number of persons were present. A notice was painted on the back of the gig, stating that Mr. Hancock had no connexion with the "Steam Carriage and Wagon Company." Every one seemed surprised at the ease with which Mr. Hancock threaded his way through the crowd of carts, omnibuses, cabs, and other vehicles in Cheapside, Leaden-hall street, and other crowded thoroughfares. The gig stopped opposite the bank for a few minutes, when the machinery was inspected by Mr. Oldham, the Engineer, who has fitted up all the printing apparatus of that establishment to be worked by steam. During Mr. Hancock's temporary absence, much amusement was caused by one of the bank porters pompously ordering the gentleman left in the gig to "move on," the latter declaring that he could not. Mr. Hancock soon returned, when the machine, obedient to the guidance of its master "moved on" in fine style, and returned without accident to Stratford. *Lond. Mech. Mag.*

LUNAR OCCULTATIONS FOR PHILADELPHIA, NOVEMBER 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
2	8	29	N. App. ☽ & 9 Tauri 6 ☽ S. 0. '9			
2	12	41	N. App. ☽ & *b* Pleiadum 4.5. ☽ S. 0. '3.			
2	12	35	Im. *d* Pleiadum,	5	113	105
2	13	53	Em.		293	327
2	13	18	Im. η Tauri,	3	121	140
2	14	34	Em.		280	327
2	14	10	Im. *f* Pleiadum,	5	83	125
2	15	19	Em.		314	8
2	14	11	Im. *h* Pleiadum,	5, 6	100	142
2	15	26	Em.		297	351
6	16	10	Im. 2 ω Cancri,	6	106	80
6	17	28	Em.		219	245
6	16	51	Im. 4 ω^2 Cancri,	6, 7	53	48
6	18	13	Em.		264	310
13	20	5	Im. α Virginis,	1	75	52
13	21	21	Em.		203	197
21	6	2	Im. 58 ω Sagittarii	6	114	141
21	7	14	Em		293	332
21	7	46	Im. 60 *a* Sagittarii,	5, 6	65	107
21	8	27	Em.		342	28
30	14	31	N. App. ☽ χ Tauri 6 ☽ N. 2. '9.			

Anti Dry-Rot Process.

The advantage arising from the application of Kyan's process for the preservation of timber, has been so generally acknowledged, and has been so well tested by experience, that its general introduction in the mining districts, is one of the natural consequences attendant on its success. It is now some months since it was first introduced in Cornwall, where its use is becoming very general; indeed, when the expense of timbering, shafts, and other uses to which timber is applied in mines, and the heavy cost attendant on works of this nature is considered, its importance must be apparent. In railway undertakings it is also adopted; and we learn with much satisfaction, that Earl Fitzwilliam has also ordered its use in the mines possessed by his lordship. This additional evidence of the estimation in which it is held, will, we feel assured, be hailed with satisfaction by all who take an interest in scientific discoveries like the present, and which in the onset, had so much to contend with, not only from popular prejudice, but from the necessity of testing it by some years experience.

Mining Journal.

Meteorological Observations for May, 1838.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise	Barometer. 2 P.M.	Wind. Direction	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	46	60	30.15	30.10	W.	Moderate.		Clear—lightly cloudy.
☾	2	46	50	00	29.85	S.E.	do.	.31	Rain—do.
	3	46	58	29.53	64	W N.	do.		Cloudy—flying clouds.
	4	44	49	74	70	E.	do.	.14	Cloudy—drizzle.
	5	42	53	50	35	E.	do.	1.24	Rain—do.
	6	46	60	45	46	S E. S.W.	do.	.7	Cloudy—do.—shower,
	7	45	62	67	70	W.S.W	do.		Lightly cloudy—do. do.
	8	45	52	70	70	N.W.	do		Lightly cloudy—drizzle.
☉	9	42	52	70	70	W.	do.		Cloudy—do.
	10	40	56	75	76	W.	Blustering		Clear—cloudy
	11	41	60	85	85	N.W.	Moderate.		Clear—clear
	12	44	70	95	70	N.W.	do.		Clear—flying clouds.
	13	52	73	70	70	W	do.		Clear—do.
	14	50	70	85	95	NE.	do.		Lightly cloudy—clear.
	15	43	73	30.06	30.10	E.S.	do.		Clear—do.
☽	16	48	78	05	05	S E.W.	do.		Fog—partially cloudy.
	17	50	77	29.70	29.70	W.	do.		Cloudy—partially cloudy.
	18	62	64	53	54	W.	do.		Cloudy—do.
	19	46	73	80	80	S.W.W.	do.		Cloudy—clear.
	20	50	80	84	80	SW.	Brisk.		Partially cloudy—clear.
	21	56	78	81	80	SW.	do.		Clear—cloudy.
	22	68	83	80	76	S.	do.	.45	Cloudy—rain
⊗	23	62	70	85	80	N.E S.	do.	.35	Drizzle—rain.
	24	64	71	66	66	SW.	do.		Showers—flying clouds-
	25	52	55	60	50	N.W.	Moderate.		Partially cloudy—rain.
	26	42	65	60	6	W.	do		Clear—flying clouds.
	27	46	78	63	50	S.W,	Brisk.	.15	Clear—flying clouds—showers.
	28	50	66	55	60	W.	Moderate.	.4	Clear—Shower.
	29	52	62	70	75	W.	do.		Cloudy—partially cloudy.
	30	46	68	85	88	W.	do.		Clear—do.
	31	54	82	90	90	W.	do.		Lightly cloudy—clear.
	Mean	49.03	66.06	29.75	29.74			275	

	Thermometer.	Barometer.
Maximum height during the month.	83.00 on 22d. . .	30.15 on 1st.
Minimum " " "	40.00 on 10th. . .	29.35 on 5th,
Mean	57.55 . . .	29.75

JOURNAL

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State of Pennsylvania,

AND

MECHANICS' REGISTER.

OCTOBER, 1838.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the determination of Latitude by the observed difference of Zenith Distances of the Fixed Stars when on the Meridian; By E. H. Courtenay, *late Professor of Mathematics in the University of Pennsylvania.*

Of the various methods which have been proposed for the determination of terrestrial latitude, none are entirely free from objections, and nearly all those which contemplate a close approximation to the truth, require either the use of very large and costly instruments, that are transported with difficulty from place to place, or demand an expenditure of time in conducting the observations, often disproportionate to the value of the result sought.

Every method therefore which promises to increase the accuracy of such results, and to abridge the time requisite for making the observations, deserves consideration.

Under this impression, it is my purpose to explain briefly, in the present paper, some of the advantages which are believed to belong more exclusively to the method of observing the difference of meridional zenith distances of such pairs of stars as culminate at short intervals, and at nearly equal altitudes, but on different sides of the zenith. So far as I can discover, this method has not been employed in Europe: and in this country, it was first adopted in 1834, by Capt. A. Talcott of the U. S. Corps of Engineers, in settling the positions of certain points connected with the question of the disputed boundary between the State of Ohio and the then Territory of Michigan. To that gentleman I was indebted not only for the suggestion of the method—but likewise for the opportunity to test its accuracy, by the use of the instrument employed by him in the service referred to. This was kindly deposited with me during the winter of 1835–36, and when repeatedly applied to the method in question was found to afford results fully justifying the favourable opinion he had formed of it from his own observations.

Principle of the method.—If we select two stars whose places have been well determined, and so situated that one shall culminate to the North, and

the other to the South of the observer, at nearly the same distances from the zenith, and within a short interval of time—and then conceive that we are provided with any means of measuring with precision *the difference* of their zenith distances, the latitude of the place of observation may be immediately deduced therefrom. For, since the declinations of the stars are supposed known—being given by the standard catalogue—the *sum* of their zenith distances, which will be equal to the *algebraic* difference of those declinations, will likewise be known; and the *difference* of their zenith distances having been determined by direct measurement, we readily obtain the absolute zenith distance of each star by simply adding or subtracting the half difference, to, or from the half sum. The latitude is computed in the ordinary way, as though the absolute zenith distances had been observed directly.

Description of the Instrument.—The instrument employed in measuring the difference of zenith distances, was that denominated by English artists a "Zenith Telescope"—consisting of a simple achromatic, mounted on a tripod stand, which admits both vertical and horizontal motions. To the tube of the telescope, a small graduated quadrant is permanently attached, the vernier of which reads to 1′ of a degree; and the movable arm of this vernier carries a very delicate spirit level serving in connection with the quadrant to place the telescope *nearly* at any required inclination to the horizon. The quadrant being used merely to facilitate the *finding* of the objects to be observed, a very rough graduation will suffice, but the extreme delicacy of the spirit level is all important, since, when once the instrument has been clamped in a particular position, the level is relied on to show whether the inclination of the axis of the telescope undergoes any change, and if so, of what amount. The tripod stand is furnished with feet-screws, with the usual provision for quick and slow motions, by the aid of which the axis of the column supporting the telescope, is rendered truly vertical. A horizontal graduated circle, reading to minutes by means of a vernier attached to the vertical column, serves to mark the position of the telescope when it has been brought into the plane of the meridian, and likewise enables the observer to turn it promptly through 180° in azimuth. Thus, when the telescope has been once adjusted to the meridian, and directed either to the North or South, it is readily brought a second time into that, or the opposite position, as occasion may require.

To the eye-tube of the telescope, a parallel-wire Micrometer is adapted, having one fixed vertical, or two movable horizontal wires of extreme fineness. Several eye-pieces, of different powers, usually accompany such a micrometer. With the one generally employed the field of view embraced an area of about 30′. The object-glass presented a clear aperture of about 3¼ inches in diameter—but as the central parts were very decidedly superior to the exterior, I generally used the telescope with a cap which exposed only an aperture varying from 1½ to 2 inches, according to the brilliancy of the object observed. The focal length of the telescope was about 42 inches.

Method of observation.—Let it be supposed that a suitable pair of stars has been selected, the difference of their zenith distances being less than 30′, the diameter of the field of view; and for the sake of explanation, let the northern star be supposed to culminate first, and at the greatest distance from the zenith. Having levelled the instrument, let the vernier of the quadrant be set to the degree and minute, corresponding to an arithmetical mean between the zenith distance of the two stars, and then let the bubble of the spirit level be brought to the middle of its scale, when the axis of the telescope will have the proper elevation for finding the two ob-

jects. The telescope is now turned in azimuth about the vertical axis of the column supporting it, until the optical axis coincides with the plane of the meridian (this position having been previously determined, and marked by means of the horizontal circle,) with the object glass directed towards the north. In this position we await the arrival of the northern star in the field of view, and as this is supposed to have the greatest zenith distance, it will, by the inversion of the telescope, appear above the centre of the field. The upper horizontal wire is now moved by its appropriate screw until it is brought to cover the image of the star, when, if the micrometer has been properly adjusted, the star will continue to traverse this wire until it leaves the field. But as the observation should be made at the instant the star culminates, we wait until it crosses at the vertical wire, keeping it constantly bisected by the horizontal wire. The position of the level should be examined immediately, taking care to note the divisions on its scale corresponding to each extremity of the bubble. If time permits, the position of the upper-wire of the micrometer, as indicated by the graduated head of its screw, may next be noted, and one-half the observation will have been completed. The telescope being then turned 180° in azimuth, retaining the same inclination to the horizon, the arrival of the Southern star is awaited, and the observation upon it conducted in a similar manner—with the exception that the *lower* horizontal wire is now used.

A very little practice will enable the observer to complete the observation on the first star, and prepare for that on the second in a period of four minutes—and after he has become expert in the adjustment of the instrument, a shorter time will suffice. Thus, if the interval between the transit exceeds four minutes, the stars, if at proper altitudes, will admit of being arranged in suitable pairs: and beyond this limit, the shorter the interval the better, as less time will be consumed in the observation, and we can feel more confident that the state of the atmosphere, and the condition of the instrument, have undergone no material change. When the interval is very short, the reading of the micrometer wire first used, may be deferred until after the completion of the observation on the second star.

The observations having been completed, a comparison of the readings of the two micrometer screws will give the difference of zenith distance of the two stars, which must be corrected, in all cases, by the readings of the level, if the extremities of the bubble have not marked the same divisions in both cases.

The advantages offered by this method may be enumerated as follows:

1. That it obviates almost entirely the errors likely to be introduced by an undue allowance for the effect of atmospheric refraction—for since it is only the half *difference* of the refractions which is applied as a correction to one-half the observed difference of Zenith Distances, and as the entire value of such correction will rarely exceed half a second, where the stars are advantageously situated, and do not differ more than 30′ in altitude, the *error* committed in estimating this correction must be extremely minute. It will be obvious also that simultaneous observations of the barometer and thermometer, always necessary when absolute altitudes or zenith distances are observed, may be wholly dispensed with, the effect due to the variations being quite inappreciable.

2. The only angular measurements required are made by means of a micrometer, the value of whose divisions may be rigidly tested by the observer as often as he may think proper, and with the greatest facility. The divisions of the micrometer may be read with perfect certainty to within

one half a second—a limit smaller than that which the optical power of the telescope will permit to be appreciated. Thus the errors usually arising from incorrect graduation and imperfect reading when verniers are employed, are in a great measure avoided.

3. The large dimensions of the telescope afford a high optical power, whilst the great simplicity of the other parts of the instrument permit its weight to be very moderate, thus rendering it extremely portable.

4. The observations are of so simple a character, that one person without the aid of an assistant, may readily conduct them, without incurring the risk of considerable mistakes, so likely to occur when the observer is hurried. And by selecting various pairs of stars, and repeating the observations on the same pairs, on successive nights, the observations may very soon be so far accumulated as to increase greatly the chances of accuracy.

5. By the use of various stars, the errors resulting from the erroneous determinations of their places (as given in the standard catalogues,) will probably tend to destroy each other, these errors lying sometimes in one direction—at others, in the contrary.

6. The instrument can be furnished at a moderate cost—is but little liable to injury or accident, and with reasonable care will very seldom require repair.

The only serious objections which are likely to be offered to this method of determining latitude, are—1st, the necessity of making our selections of stars from those whose places have not been settled with the greatest accuracy: and 2d, the necessity of computing the true places of the stars on the days of observation.

To the first of these objections it may be answered, that the places of a very large number of stars have now been determined with such precision, as to afford numerous pairs suitable for all northern latitudes, and almost certainly to be relied on to within 3 or 4 seconds at the utmost—in most cases, to a much smaller limit. The second objection will also be found to have less weight than would be generally attached to it, when the computor has accustomed himself to the use of the admirable table of constants given in the Catalogue of the Astronomical Society of London, in connection with the constants now furnished by the Nautical Almanac.

When a pair of stars has been selected, their places may be computed for every tenth day during two or three months, with very little more labour than would be requisite to determine them on two or three different days during that period, and as their places may vary very slowly, a simple proportion will suffice to determine them at any intermediate epoch.

It will also occasionally happen that one or more pairs of suitable stars can be selected from the catalogue of 100 stars, whose true places are now given for every tenth day in the Nautical Almanac, and the necessity of computing the effects of aberration, precession and nutation will then be entirely superseded.

There are cases also when the objection first alluded to, that of placing too great a reliance on the places of those stars whose declinations have not been determined with great precision, becomes entirely unimportant. When, for example, it is proposed to find only the *difference* of latitude between two places situated nearly on the same parallel, it will frequently occur that the same pairs of stars may be observed at both places. In such cases, the same error being introduced into each latitude by an erroneous estimate of the declinations of the stars, it will disappear when the *difference* of those latitudes only is considered; and, if in addition, the latitude

of one of the places has been very carefully determined by other means, this method of observation will furnish a simple and very accurate mode of settling the latitudes of other adjacent places.

For the purpose of presenting a simple and clear view of the degree of accuracy which may be expected with this method of observation, a table is annexed, exhibiting the results of a series of observations undertaken by myself in the winter of 1835–6, for the express purpose of testing its efficiency. The mean places of the stars, used in deducing the latitude were taken exclusively from Pond's Catalogue of 1112 stars; and their true places were computed by means of the constants in the catalogue of the Astronomical Society, whenever the same stars were likewise found in the latter catalogue. In other cases, the constants were computed directly by the usual formulæ.

It may be proper to remark that the results here given have not been selected with any reference to their more exact agreement with each other; but on the contrary, they present a perfectly fair view of what may be anticipated from this method of observation, as soon as the observer has acquired a moderate share of skill in the use of the Instrument. Indeed the only observations which have been excluded, were those in which it was found, upon trial, to be impossible to make the observations satisfactorily, in consequence of the stars being very near the extremities of the field of view. This would, of course, happen only when the difference of their zenith distances, was nearly 30′.

In making these observations, the instrument was placed on a stand in the yard of my house in Philadelphia at the S. E. corner of Spruce and Broad streets, the centre of the stand being 90 feet from the front on Spruce, and 5½ from that on Broad street: and as nearly as I can estimate from the plan of the City about 7.″ 93 South of the steeple of Independence Hall. The latitude of that building as given in the American Almanac, is

	39.° 56′ 59.″ 00
From which subtracting 7.″ 93	7.″ 93
Leaves the latitude of the spot occupied by the instrument,	39.° 56′ 51.″ 07
And the general mean of my observations shewn in the annexed abstracts,	39° 56′ 50.″ 60
Difference,	0.″ 47

I am unable to state in what manner the result given in the Almanac was obtained, and cannot judge therefore of the degree of reliance to be placed on it. Most probably it has been determined with considerable care—and if so, the close agreement of the two results is a strong evidence in favor of their accuracy.

Abstract of Results furnished by a Series of Observations for Latitude of the difference of Zenith Distances of N. and S. Stars; the Instrument employed being a Zenith Telescope, furnished with a Level and Micrometer.

Date.	Pairs of Stars.	Latitude.
1835.		
Nov. 20	υ Pagasi & 2807 Cassiopia	39° 56′ 48″.83
25	" "	47″.37
Dec 1	" "	50″.56
3	" "	49″.32
8	" "	48″.18
22	" "	50″.55
23	" "	49″.8[illegible]
Nov. 20	υ Pegasi & τ Cassiopia	47″.84
25	" "	48″.11
Dec 1	" "	49″.52
8	" "	47″.26
22	" "	50″.57
23	" "	49″.26
Nov. 21	ο Piscium & 209 Cassiopia	51″.26
25	" "	50″.76
26	" "	51″.12
28	" "	49″.78
Dec. 23	" "	51″.04
Nov. 25	δ Cephei & λ Pegasi	49″.52
Dec. 1	" "	51″.94
3	" "	50″.39
23	" "	51″.11
23	ξ^2 Arietis & ν Custa Mess	51″.44
Nov. 25	ζ Cephei & λ Pegasi,	46″.36
Dec. 3	" "	48″.46
Nov. 21	209 Cassiopia & ξ′ Ceti	52″.13
25	" "	52″.19
26	" "	51″.18
28	" "	51″.99
Dec. 23	" "	50″.87
1836.		
Jan. 23	" "	51″.31
1835.		
Dec. 23	287 Arietis & γ Persei	51″.78
1836.		
Jan. 23	" "	51″.68
1835.		
Dec. 23	304 Arietis & γ Persei	53″.58
1836.		
Jan. 23	" "	53″.87
1835.		
Dec. 23	ξ Arietis & 371 Camelop.	54″.99
1836.		
Jan. 23	" "	53″.39

D e.	Pairs of Stars.	Latitude.
1836.		
J.n. 23	π Tauri & 552 Camelop.	39° 56′ 50″.18
Feb. 10	" "	48″.11
10	834 Camelop. & 840 Monoc.	52″ 67
M'ch 23	" "	50″.49
April 6	ο Ursæ Maj. & θ Cancri	53″.00
6	1148 Ursæ Maj. & π Leonis	50″.13
Feb. 10	765 Camelop. & γ Geminor.	48″.67
10	764 Camelop. & χ Orionis	46″.59
10	764 Camelop. & γ Geminor	48″.50
10	764 Camelop. & χ^3 Orionis	48″.83
10	715 Camelop. & χ^3 Orionis	49″.00
10	715 Camelop. & χ^1 Orionis	46″.75
Jan. 23	552 Camelop. & c′ Orionis	53″.67
May 12	o^2 Camelop. & θ Virginis	51″.27
13	" "	54″.30
12	o′ Camelop. & θ Virginis	49″.36
13	" "	52″.63
8	λ Draconis & ο Virginis	51″.44
10	" "	51″.89
12	" "	51″.20
8	θ Virginis & k Draconis	49″.90
9	" "	51″.85
10	" "	51″.66
12	" "	50″.45
13	" "	51″.62
May 6	ξ′ Virginis & k Draconis	47″.84
8	" "	50″.59
12	" "	50″.90
Ap'l 24	λ Draconis & ξ′ Virginis	51″.32
May 5	" "	52″.28
8	" "	51″.90
12	" "	51″.76
Ap'l 24	ρ Leonis & 126 Ursæ Maj.	51″.05
May 8	" "	50″.41
9	" "	50″.58
10	" "	50′.53
1[illegible]	" "	51″.44

TABLE CONTINUED.

General mean,	39° 56′ 50″.60	Mean of the 26 observations in April and May,	39° 56′ 51″.20
Greatest variation from mean,	4 39	Greatest variation from mean,	3. 36
3 variations exceeding	4	2 variations exceeding	3
6 betwen	3 & 4	0 between	2 & 3
10 between	2 & 3	6 "	1 & 2
23 between	1 & 2	18 below	1
32 below	1		
Mean variation of the entire series of 74 observations.	1. 39	Mean variation of the 26 observations.	0. 89

If the places of the several stars observed were given with absolute accuracy, it would be proper to take a general mean of all the *independent* results, thus assigning an equal weight to each observation—and for the sake of simplicity this has been done—although, strictly speaking, the places of certain stars having been determined by a large, others by a very small number of observations, the positions of the former are to be relied on with greater confidence than those of the latter. It may also be observed that the results given in the preceding table, are not *all* perfectly independent. For in some instances it was found possible to combine more than two stars; when, for example, one northern star having nearly the same zenith distance as two southern stars, could be observed without a change in the inclination of the telescope, two different results would be given by *three* observations, whereas *four* would usually be required. It has been deemed sufficient, however, for the present purpose to compare the separate results with an indiscriminate mean, a slight variation in which would have but little influence on such comparison. By subtracting each result separately from the general mean, it will appear that the extreme variation from the mean is but 4″.39, and that the average variation from the same quantity in the entire series of 74 observations is 1″.39. An examination of the table will also exhibit very satisfactorily the rapid diminution in the number of errors as the limits of error are increased, there being but 3 errors exceeding 4″—8 between 3″ and 4″—10 between 2″ and 3″—23 between 1″ and and 2″ and 32 below 1″.

It was reasonable to expect that the observations latest in point of date would present results yet more nearly accordant with each other, than those afforded by the entire series, as some time was requisite to acquire the habit of using the instrument in a manner entirely satisfactory. Accordingly, a comparison was made of the 26 observations latest in point of date—the results of which are given in the table. In this series the average variation from the general mean is reduced to 0″.89; the greatest variation to 3″.36, and 24 out of the 26 errors are below 2″.

Undoubtedly very many of the larger discrepancies are to be ascribed to erroneous assumptions of the places of the stars—not to the errors of observation. This will appear very clearly by comparing the different results given by the same pair of stars on different nights. The greatest difference between any two results thus obtained, will be found to be 3″.27.; whereas the extreme difference between the greatest and least in the entire series is more than double the quantity.

Whilst insisting earnestly upon the advantages of the method of observation above described; it is not pretended that each of these advantages may not be secured separately by other methods; but it is doubted whether any other combines in so great a degree the recommendation of convenience, accuracy and despatch.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks relating to the Storm of March 17th, 1838. By James P. Espy.

PART I.—CONDENSED STATEMENT OF THE FACTS.

It appears from the facts detailed in the report of the committee on Meteorology*, that a storm of rain and snow of great violence was raging on the 17th of March, reaching N.E. and S.W. from the Western extremity of N. Carolina to the N.E. extremity of Pennsylvania—and in a N.W. and S.E. direction, from about the middle of Ohio, to the Eastern extremity of N. Carolina, and East and West from beyond Lexington, Kentucky, to some distance into the Atlantic beyond the Eastern shore of Maryland. The storm was much the greatest on the 17th, and its boundaries on this day about noon, have been represented by the middle circle in the map accompanying the report of the committee. This storm moved along the surface of the earth nearly towards the East.

It appears that the Barometer fell on the 17th in all places near the centre or far within the boundaries of the storm—and rose in many places near its borders, and beyond them; especially in the extreme W. and NE. (see Lexington, and Montreal, and Providence, and Middletown.)

It appears also—what might naturally be expected from the fall of the Barometer within the storm—that the wind at the borders and for some distance beyond, blew inwards, towards the storm. The information which we have at present does not, enable us to know whether the Barometer stood lowest in the very middle of the storm or not. If it did—and there were no general currents in the atmosphere to produce oblique forces, the laws of dynamics justify us in expecting the wind in such case to blow *inwards* from the circumference, exactly towards the centre, just as we would expect the wind to blow outwards *from* the centre of a storm—if there was any cause in nature to make the Barometer stand constantly higher at that point than in the circumference.

By casting the eye on the map accompanying the report, it will be seen that there is no one point at which all the arrows, if prolonged, would meet. There is indeed much irregularity in this respect. For example the arrow near Jamestown, N. Carolina, which is south of the centre of the storm, still shows the wind N.E.; as if the point of greatest depression of the Barometer, was near the southern border of the storm; somewhere in N. Carolina: while in the Northern part of the storm, the arrow for Silver Lake, shews the wind to be N.W.; as if the point of greatest depression of the Barometer was near the North part of the storm.

And yet, if the strong winds be considered in the extreme boundaries of the storm, for example, Springfield and Wilmington, in Ohio, and in the east (all the observations from the Chesapeake to New York,) these arrows being prolonged will meet very little south of the centre of the storm; and, as the winds were all strong and steady, for many hours, and were under the *general* influence of the whole storm, and not affected by any *particular* localities, they speak a language which cannot be mistaken.

The wind could not blow thus strongly inwards for many hours without moving upward in the centre of convergeance: whether that was the centre of the storm or not, and as the barometer continued to fall in the region of the storm during the whole day, the air must have flowed outwards from the region of the storm *above* even faster at first than it flowed in-

*See this Journal for last month.

wards *below*, otherwise the barometer would not have fallen within the storm.

The storm was so nearly round on the 16th and 17th, that it would be an affectation of accuracy beyond our data, to give any other figure in the topographical chart. It was also so nearly the same size on each of those days that it is impossible to say on which day it covered the largest territory, the quantity of rain and snow known on the 16th, was small, while that on the 17th was very great. But on the 18th, it greatly increased its size, (*if it remained round*,) for on that day its diameter from S.W. to N.E. along our coast was more than 600 miles, reaching from N. Carolina, to Maine. Whereas on the two preceding days it was only about 500 in diameter.

From the 16th to the 17th, the storm travelled towards the East or even a little South of East: for on the 16th there was considerable snow in the Southern part of Michigan, and on the night of the 16th, and on the 17th, there was very little snow at Meadville, Pennsylvania; though Meadville is on a lower latitude. But on the 18th the storm manifestly moved towards a point North of East, for, at half past one P. M., it began to snow in Portland, Maine, 2 degrees further North, than it extended while in Pennsylvania.

Whether this extension of the storm further North, depended on the direction in which its centre was moving, or on a general widening out of the storm, cannot be determined; as its southern boundaries on that day are not strictly defined by the facts collected. It certainly extended down to Lat. 38° in Long. 73°, wind still N.E. And there were strong gales W.S.W., about that time. from Lat 31° to Lat. 34°. Though the packet ship Algonquin, in Lat 37° 50′ (Long. and time of day not given) says nothing of the storm of that day—but speaks of the one on the day before, it would be extremely desirable to know what her log-book says of the storm after she took the gale E.b.N. near the Delaware Capes, at 8 A. M. of the 17th, and then hauled off. As she went to the South—her log would probably be able to answer a very interesting question which our present information leaves undetermined. *In what direction and with what force did the wind blow on the South East side of the storm on the 17th.**

This storm travelled with a velocity of about 18$\frac{1}{8}$ miles an hour from beginning to beginning. It was just one day in reaching Philadelphia, after it commenced in Springfield, Ohio; a distance of about 435 miles, and a comparison with other points agrees well with this.

There is one *apparent* anomaly worthy of particular notice. On the N.N.E. of the storm 80 or 100 miles beyond its extreme boundary, there is a region, from which the wind seems to have blown outwards in all directions.

Albany seems to be included in this region—and if it shall be found, that at Albany and the town near it, or perhaps as far West as Utica, the barometer rose considerably on the morning of the 17th, one step will be made in the explanation of this phenomenon, whatever may be the cause of this rise.

But the two most remarkable irregularities of all will be found at Meadville, Pennsylvania, and Lexington, Kentucky.

*Any further information concerning this storm will be gladly received. If every person keeping a journal of the weather within and for some distance beyond its boundary would send a copy of it for the 15th, 16th, 17th, and 18th March, the apparent irregularities of this storm would probably be explained.

Here the wind seemed to blow almost in a tangent to the storm. There is an irregularity somewhat similar to this on the South East side of the storm at New Garden, N.C. where the wind was N. E. all day, probably not strong, as the force is not mentioned. In short, by casting the eye on the chart it will appear, by directing the attention to the N.W. side of the storm, that the wind had a tendency to rotate from right to left; and again, if the attention be directed to the S.E. side of the storm, it will appear that the wind had a tendency to rotate from left to right—which precludes the idea of a general rotation the same way—and shews that there was some cause which induced the wind at the extreme N.W. and S.E. and E. to move towards a point in the storm, south of its centre. These anomalies cannot be explained fully by the facts collected without the aid of hypothesis, and I do not permit myself to *hypothesise*. We have no barometrical observations South of Washington; yet from the immense quantity of rain and snow which fell in the Northwest corner of N. Carolina, it is not improbable that a much greater quantity fell in the Southern part of the storm than in the Northern.

Besides, as the barometer fell much more at Washington city than at Philadelphia, and places further North, it may be that it fell still more further South and West. But I forbear to conjecture.

Part II.—Rationale.

It will not be esteemed by the reader impertinent in me to offer my views as to the modus operandi of nature in producing the various phenomena accompanying the storm of the 17th March, as detailed in the "Report" of the Meteorological Committee, and summed up in the preceding "Remarks."

The upward motion of the air in the region of a storm, may take its commencement either from a higher temperature, or a higher dew-point.

As the air rises in the inner portions of the storm, it is reduced in temperature by diminished pressure, a little more than one degree for every hundred yards of its ascent, as I have ascertained by experiment; and when it has ascended as many hundred yards as the temperature of the air is above the dew-point, the vapour will begin to condense into cloud, and give out its caloric of elasticity—this caloric of elasticity is received by the air in contact with the condensing vapour, and prevents the air in its further ascent from cooling as fast as it would, if there was no vapour in the air to condense; and, I find, both by calculation and experiment, that in ordinary states of the dew-point, it cools only one-half degree each hundred yard of its ascent above the base or lower part of the cloud; and that in all states of the dew-point, the air in the cloud at the moment of its formation, is expanded about 5600 cubic feet for every cubic foot of water generated by the condensed vapour, after making allowance for the condensation of the vapour itself.

This great expansion of the air in the cloud will cause a rapid ascent and out-spreading above, which will cause the barometer to fall under the cloud, and if there was no current above, it would spread out on all sides equally in an *annulus*, and cause the barometer to rise all round the storm, as much on one side as another. But as there is known to be an upper current always, or almost always, moving in this latitude towards the N.E. or E.N.E., this current will cause the out-spreading of the air to be chiefly in that direction, and consequently the barometer will rise chiefly on that side of the storm, at the very time it is falling within the storm, as it actually did in Connecticut and Rhode Island, while it was falling in Annapolis and

Washington City. Now if it should be found that the rise extended to Albany and Utica, the explanation of that remarkable phenomenon mentioned before, of the winds blowing outwards in all directions from that region, it will be acknowledged that this is the true explanation of it.

If it should be found that the barometer did not rise at these places, some other facts may yet be discovered to explain the anomaly.

On the very great irregularities presented at Meadville and Lexington, I have nothing entirely satisfactory to say. In a storm of such great magnitude, many irregularities might be expected.

I have been told by those who have witnessed the phenomenon, from very lofty mountains, when it is raining in the valley below them, that the top of the cloud, which they could see spread out before them, did not exhibit a level plain, but many pyramidal elevations were to be seen rising considerably above the ordinary level. Now this seemed to indicate a more violent action under those elevations than in the other parts—and if we conceive the action very great, as it is in all summer hail storms, in which the drops of water are carried up to a great height and frozen—the snow might not be permitted to fall down where it was generated, but be carried off to some distance from where it was taken up, and thrown down in such quantity as to cause, by its weight and cooling effect together, the wind to blow outwards in all directions from its place of descent. Many such places might be formed in a storm, 500 miles in diameter, and, of course, many irregularities be produced, similar to the one in question. These particular, violent, upmoving currents, and down-falls of snow by their side, would be very likely to occur in the neighbourhoods of hills and mountains. For, the air rushing in towards the centre of the general storm, on coming to a hill, will glance up it, and, having acquired an upward motion, will be inclined to continue it, and thus produce the effect in question. For if the hill is very lofty, as the Himalehs, the snow will be thrown down on the windward side; but if it is of moderate elevation, the snow may be thrown down on the leeward side. In the former case the wind may be forced down the side of the mountain on the windward side at the surface of the ground, whilst a few hundred yards high, it may be blowing up the mountain over that at the surface of the earth blowing downwards. This is probably the case in what is called the *helm-wind* in England.

It is also known that a violent summer's shower often causes the wind to blow outwards in all directions from the falling shower, when a few minutes before it had been blowing the contrary way, towards the forming cloud, and the wind at some considerable distance from the falling shower, still continues to blow towards the rain, glancing up over the out-moving current. In this way, new columnar clouds are seen to form rapidly to the windward of the rain cloud. If, during the progress of a great storm, it should sometimes snow or rain violently, and at other times stop, with increase or diminution of wind, it might be safely inferred that some such action as that just described is going on. In that case, too, a person below the clouds may sometimes distinguish these cones, which raise their tops above the general level of the cloud above, for their bases will be much blacker than the surrounding clouds. After all, we must wait for future and more abundant facts to explain these irregularities.

As to the direction in which the storm moved and its velocity, we have but little to say; because it is entirely beyond the power of the theory to predict in what direction storms in general will move. It is highly probable indeed, that very narrow storms of great violence, such as tornadoes, in

which the drops of rain are not permitted to fall back through the ascending current, but are thrown outwards, at a great height, frozen into hail, will all be found to move in the direction of the upper-current—that is, westwardly, or, towards the west in the torrid zone, northwardly from the tropic of Cancer to latitude 30, and northeasterly, or eastwardly in the latitude of Philadelphia.

For the tornado cloud, forming only when the dew-point is very high—that is when the steam-power in the air is very great (for all storms are produced by steam-power,) it will rise very high, and of course a large portion of its upper part, being in the upper current of air, it will be pressed by that current in its own direction. Therefore the tornado, as long as it lasts, must move in that direction. But in case the rain falls down through the base of the cloud, as in ordinary showers, the descent of the rain produces a disturbing force below, and the accumulation of drops of rain in the cloud prevents the cloud from rising so high into the upper current as in the tornado cloud, and besides the air, on the northern border of the storm being colder and of a lower dew-point, will, by its greater weight, have a tendency to press the storm towards the south, and these forces not being exactly known in quantity, we must wait till a patient induction from accumulated facts shall solve this most interesting problem.

Another highly interesting question can only be answered by very numerous observations with the barometer. How far is the snow and rain carried by the out-moving current above, beyond the up-moving current in the middle of the storm?

This distance will no doubt vary with the violence of the storm. In a case of great violence, if the storm is quite narrow, the upward current in the middle may be so great that the snow or rain may not be permitted to fall in the centre of the up-moving current at all—but be compelled to pass outward above in all directions, and fall down in an annulus, where the barometer may even be above the mean, and rise during the fall. Something of this kind seems to have taken place in the present storm, in the northern part of Pennsylvania, extending from Sunbury and Silver lake, even as far down into the centre of the State as Bellefonte. For, at the two former places the barometer did not fall at all, and at the latter, its fall was hardly sensible. At these places, therefore, it is highly probable, there was no upward current of air, and consequently the snow which fell there, must have been generated at a distance. How far this fall of snow may have been, not only the cause of the irregularities at Silver Lake and Meadville, which were mentioned before, and of the very gentle winds about this region, but also of the general tendency of the winds to move on the east and west side of the storm towards a point south of the centre, it is not necessary for me now to determine; at present it is sufficient to have pointed out this source of irregularity, and leave it to future investigation to determine its exact amount.

Another highly important question is suggested here—how far beyond the boundary of the falling rain or snow in these wide extended storms, does the wind blow inwards towards the storm? And how long before the beginning of the rain or snow, does the wind change in front of the storm? It seems probable that the time and distance to which the in-blowing extends, will be directly as the magnitude of the storm, and the facts ascertained are favorable to this deduction. At Philadelphia the wind changed round by N. to N.E. exactly 24 hours before the rain commenced. At Middletown, Conn., the wind changed about 24 hours before the storm came on. At New Bedford and Northborough, Mass., and at Providence, R. I., the wind

changed round from 30 to 40 hours before the commencement of the snow. But in no case did it become so violent as to attract much attention, until within a few hours of the commencement of the rain or snow. I say rain or snow, for in the northern parts of this storm, it was snow, and in the southern parts, rain and hail. And it is worthy of particular remark, that during the whole progress of this storm as far as our observations reach, the wind was most violent on the N.E. of the storm, and least violent on the S.W. of it. This is what we ought to expect from the rise of the barometer on the N.E. side of the storm, as mentioned before. I have in my possession proofs that this is the case in *some* other wide-extended storms; further investigation must decide whether it is the case in *all* such storms.

Even in those very narrow storms called *Spouts*, I have been informed by eye-witnesses that some have the trees thrown down contrary to the motion of the spout along the surface of the earth. Such has not been the fact in those spouts which I have visited. In all I found the tops of the trees on the south side of the spout lying towards the N. E., on the north side towards the S.E., and if occasionally trees were lying across, those underneath were thrown inwards and backwards, and those on top were thrown inwards and forwards. The Brunswick spout of the 19th June, 1835, affords a well known example of this, an account of which is given by A. D. Bache, President of the Griard College, in the transactions of the American Philosophical Society, and also by Professor W. R. Johnston, in the Transactions of the Philadelphia Academy of Natural Sciences.

Another remarkable fact will not escape the observation of the reader, who examines with care the report of this storm. The wind on the 16th, before very much rain and snow had fallen, was every where feeble and irregular, and especially so in the New England states; but on the 17th, when much rain and snow had already fallen, the wind became strong, and the irregularities nearly ceased. So on the western border of the storm, at Wilmington, for instance, the wind was much stronger on the 17th than it had been on the 16th.

The several links of our chain of argument may now be exhibited in juxtaposition.

1. The air did blow inwards towards a region not far from the southern border of the storm.
2. The air did therefore ascend over that region.
3. It cooled a little more than one degree of Fahrenheit for every hundred yards of its ascent, as is known by experiment.
4. When it ascended as many hundred yards as the temperature of the air was above the dew-point, the vapour in the air would begin to condense into cloud.
5. When the vapour began to condense, its caloric of elasticity would be given out to the air in contact with the condensing vapour.
6. This caloric of elasticity would change the law of cooling, in ordinary states of the dew-point, from one degree for a hundred yards of the ascent to one-half a degree, so that the air *in* the cloud was one-half a degree warmer than the air on the *outside* of the cloud, for every hundred yards above its base.
7. The specific gravity of the cloud will thus be less than that of the air at the same height, a quantity which can be calculated if the dew-point and the height of the cloud are given.

* It has since been ascertained that the wind on the 17th, was extremely violent all day at Emmitsburg, Maryland, from N. to N.W.

8. The air in the cloud will therefore move upwards in the middle, and outwards above, and inwards below, with a depression of the barometer under the cloud, and a rise all round the cloud, produced by the outspreading of the air above.

9. If the depression of the barometer is given, the velocity of the upward motion will be known, at least in the case of tornadoes or spouts.

10. If the velocity of upward motion is known, the quantity of vapour condensed in a given time is known.

11. The commencement of this upward motion may depend either on a higher temperature, or a higher dew-point than in surrounding regions.

12. The barometer would probably rise more on the N.E. side of the storm than on any other side, on account of the general motion of the upper portion of the atmosphere, being towards the N.E. in this latitude.

Franklin Institute.

Circular of the Committee on Meteorology.

Sir:—The occurrence of a storm of unusual violence, on or about the 11th of September, current, induces the committee again to address their correspondents and others who may feel an interest in the promotion of Science, to request of them such information as they may be able to furnish upon the following points;

1st. When did the storm immediately preceding the 13th September 1838, commence and terminate?

2nd. In what direction did the wind blow, and with what force during the storm?

3rd. Was there much or little rain? If the observer was beyond the boundary of the storm, how did the wind blow as to strength and direction during the 11th 12th, and 13th?

Should the committee receive such answers to their questions as may enable them to ascertain the chief phases of this storm, it is their intention to publish a report of the same, which they will have pleasure in transmitting to you.

The reports received relative to the storm of the 16th, 17th and 18th of March last, have been collated, and will be published in a few days, accompanied by a map of the United States, upon which is delineated the apparent path of the storm; copies of the report and the map, will be forwarded to the correspondents of the committee at an early day.

Any further facts relating to this storm, particularly from Maryland, Virginia or North Carolina, will be highly acceptable.

Communications to be addressed to William Hamilton, Actuary—Franklin Institute, Philadelphia.

Robert Dungleson,
Alex. Dallas Bache,
James P. Espy,
Charles N. Bancker,
John K. Kane,
Henry D. Rogers,
Sears C. Walker,
Robert M. Patterson,
John C. Cresson,
Gouverner Emerson.
Committee on Meteorology.

Philadelphia, September 18th, 1838.

Mechanics' Register.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER 1837

With Remarks and Exemplifications by the Editor.

386. For an improvement in the *Machine for Sawing Shingles;* Zebulon Sargent, Contocookville, Miama county, New Hampshire, December 1.

This machine is dependent for its novelty upon the particular arrangement of its parts, for the effecting of an object which is accomplished by a large number of shingle machines, the claim being to "the mode of gauging the thickness of the shingle, and vibrating the bolt, so as to present alternately a tip and a but to the saw, in the manner described; and to the combination of the various parts as described, for running back the carriage."

387. For an improved *Cooking Stove;* Nathaniel Walker, Dighton, Bristol county, Massachusetts, December 1.

"What the inventor claims as original, and invented or discovered by himself, is the movable sliding box and grate for burning anthracite coal, constructed as described; the particular manner of dividing the fire room into an upper and lower chamber; the dividing the upper chamber into two apartments for the purpose of insulating either chamber, and directing the whole power of the fire into either, by means of the damper before described; and the manner of affixing the sliding plate between the fire room and the oven, by which the bottom of the oven is made accessible."

The foregoing is a formidable list of claims, yet the stove to which they refer, is in its general construction like many others; the things claimed to be done, have, generally speaking, been previously effected, but the mode of accomplishing them is varied; whether those who use this stove will find these variations to constitute real improvements, is a question which they may answer.

388. For an improvement in the *Steering Wheel, for Ships and other Vessels;* Andrew Thorne, Boston, Suffolk county, Massachusetts, December 1.

The wheel referred to, is the common vertical steering wheel, which may be made to act directly upon the barrel on which the steering rope is wound, or may be disengaged so as to turn independently of it, when it may be thrown into gear with a spur wheel and pinion, to increase the effect of the power applied. The claim is to "the combination with the steering wheel of a series of toothed wheels of varying diameters, arranged and brought into gear as described, or by any other of the known or common methods by which a change may be easily and instantly produced in the effective power, by a change of gearing, so that the man at the wheel can at pleasure give to it a greater or less power over the tiller, as light, or strong winds may render necessary, or desirable."

The mode of engaging and disengaging, applied to the steering wheel as

described in the above named patent, is common in machinery of various kinds. It is, for example, used in capstans, and, probably, has been employed on steering wheels also; but, of course, this was not in evidence, or the patent would not have issued; it will be seen that no pretence is made to any novelty in the manner of changing the gear.

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389. For an improvement in the *machine for Sizing Paper;* John Ames, jr. Springfield, Hampden county, Massachusetts, December 1. (See Specification.)

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390. For improvements in the mode of constructing *Saw Mills, for Sawing Timber;* John Ambler, city of Philadelphia, December 1. (See Specification.)

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391. For an improved *Machine for preparing Ice for Shipping and Storing;* Nathaniel J. Wyeth, Cambridge, Massachusetts, December 1.

This machine consists, principally, of an iron frame which may be about three feet long, and two feet wide, the parallel sides having iron plates upon them, the lower edges of which are to run in grooves previously made in the ice to guide them. There are to be steel cutters, held in place like the cutting iron of a grooving plane, which are to cut the ice, as the machine passes along. It is to be drawn by a horse, and to have a man seated on it, whose weight will cause the cutters to operate. There is, also, a cutting knife, which crosses the machine, and is to shave off the surface, when necessary to remove snow, or other matter, therefrom. The claim is to "the combination of the various parts and portions described, in such a manner as to form the machine aforesaid."

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392. For improvements in the construction of the *Saw Cylinder for Cotton Gins;* Jacob Idler, city of Philadelphia, December 1.

This patent is taken for the employment of metallic rings between each of the saws, in order to keep them apart. These rings are to be cast with arms, in the manner of ordinary cast wheels; the spaces between the wheels will, it is said, allow room for the buckle in any of the saws to be relieved without the edges being affected thereby. An iron shaft is to pass through the centres of these disks, and of the saws, which are to be wedged, or screwed up, in the ordinary way.

The claim is to "the forming the cylinder of the said cotton gin with hollow cylindrical metallic sections; with projections or bearings on the sides of the arms and ends of the sockets of said sections, for sustaining, in conjunction with the sides of the rings or sections, the circular saw plate, in a firm and true position on the shaft, and parallel with each other; the spaces formed between the arms and bearings, allowing room for the swellings or bucklings of the saws, so that the part of each saw plate outside of the cylinder, which runs between the ribs or combs of the gin, shall always be true and even."

We believe that gin saws are not now usually made of round plates of steel, like circular saws, but of two, flat semi-hoops, the inner edges of

which are confined between the disks by which the saws are divided; these are cheaper than whole plates, and are less liable to buckle.

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393. For improvements in the *Machine for Steaming and Mashing Apples;* John Dimm, Greenwood, Juniata County, Pennsylvania, December 1.

This apparatus is to prepare apples for fermentation by steaming and crushing them, so as to reduce them to a pulp, or pommage. A rectangular box is made, across which there are two fluted rollers for crushing the apples; this box is surmounted by a hopper, having a close lid, to retain the steam which is to be introduced into it. Above the crushing rollers there is a horizontal sliding shutter, fitting the box, and supporting the apples in the hopper. This shutter is made of two boards placed one above the other, and having a space between them into which the steam is to be introduced through a suitable tube.

The upper board is perforated, so as to allow the steam to pass through, and to act upon the apples in the hopper; when they are sufficiently steamed the sliding shutter is withdrawn, and the apples then rest on the fluted cylinders. Motion being given to these, by a winch, the apples are reduced to pulp, and fall upon an inclined trough below, which conducts the pulp away, prepared for the fermenting tub. The claim is to "the combination of the steaming apparatus with the mashing cylinders, for mashing apples, as above described."

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394. For an improved *Excavating Machine;* Thomas Claton, Shelbyville, Shelby county, Indiana, December 1.

Claim. "I do not claim the employment of a box, to receive and carry off the earth; but what I do claim, is the form of the bottom of the plough, being made with two plane surfaces, instead of curved, as is usual; the line forming the angles of these planes, being so situated that the weight of the earth, when the box is full, will throw the front of the plough up, as set forth."

This plough, as it is called, resembles the common scraper in having a cutting edge in front, and a box to receive the earth. On one of its sides there is a beam like that of the plough, and carrying a coulter. The share, or cutting edge of the box, runs obliquely, to cause it to cut the more easily.

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395. For an improvement on the *Plough;* Stephen McCormick, Fauquier county, Virginia, originally patented by him on the 28th of January 1826: December 1.

The claims must suffice to give all the information we can afford respecting this plough; they are to "the curved form given to the heel of the landside, and also the concave form given to its back edge as it rises from the heel to the beam. Also the manner of stocking the plough; likewise the cast-iron claevis, formed and attached to the beam, as set forth; that is to say, embracing the beam by its concave part, and having a ridge let into the beam, and the bolt inclined backward to resist the direct action of the draught."

396. For an improved *Machine for Sawing through Trees, &c;* Samuel H. Hamilton, city of New York, December 7.

This is an ingeniously contrived machine, intended, principally, for the purpose of sawing down trees, but which may also be adapted to the cross-cutting them after they have been felled. The machine is to be drawn from place to place upon two wheels. The saw is made stiff, as it has no straining frame, but stands out from the machine like a key-hole saw from its handle. The gearing by which it is driven is operated upon by means of a vertical wheel, which is turned by a winch. This acts also as a fly wheel, and is at the same time bevil-geared into a horizontal wheel which gives motion to the crank that operates on the saw. The frame of the machine is sustained, in front, upon a roller resting on a curved way, and this frame turns on a vertical shaft in the centre of the curvature of the way, allowing the frame, with the projecting saw, to move round, so that in the operation of cutting it may be made to bear continually against the tree; a weight hanging over a pulley serves to keep it up to its bearing. The claims need not be given, as they refer to the arrangement of the respective parts, as described.

Under particular circumstances, trees may, no doubt, be advantageously cut by such a saw; but for felling in the woods we do not look for any thing superior, or equal, to a good American axe and axeman. Such a machine as that described, cannot be moved about in the woods in a new country; and in most situations whilst it was being prepared, and anchored, the axeman would be able unaided, to complete the work. There are other serious objections to sawing machines for felling. The saw will bind in the kerf, in spite of all precautions; even the wind alone, were there no other cause, would frequently produce this effect. The axeman can always determine one of two ways in which his tree shall fall, but not so with the manager of the saw; and woe to his machine, when a tree falls upon it, an event which is not only possible, but very probable.

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397. For manufacturing *Boots and Shoes of India Rubber;* Stephen C. Smith, city of New York, December 7. (See Specification.)

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398. For improvements in the *Action of Piano Fortes, and in the mode of giving stability to such instruments;* Thomas Loud, city of Philadelphia, December 7.

Claim. "The improvement claimed, and wished to be secured by Letters Patent, in this modification of the action, (the front motion grand action) is the application of the jack, or grasshopper, immediately to the hammer block, with a front motion, or towards the centre of the hammer, together with the front regulation of the jack, or grass-hopper, when the jack is thus applied at once to the hammer block. And also in what I denominate my *metallic supporting brace*, in the turning pins or long block, of piano fortes, to form supports to the metallic plates by braces, tubes, or otherwise, for more than one point of its strain; the said supporting brace being continuous, either in one or more pieces, and being placed in, or attached to, the turning pin, or long block, to receive the strain from the metallic plate, arising from the tension of the strings, either by its touching the plate, or by braces or tubes attached to it in the manner, or upon the principle, herein fully made known; also, in the detached metallic plate, in the detaching of the plate from the back end of the case, except at the ends of the plate where it is screwed to keep it level."

399. For an improved mode of *applying heat to Cooking Stoves;* Jonathan G. Hathway, Painsville, Geauga county, Ohio, December 7.

This stove is generally to be constructed with two ovens, one above the other, and the fire compartment is to be over the upper oven. Sometimes, however, there is to be but a single oven, whilst the other parts which are depended upon as the foundation of a claim, are still retained. The novelty consists in the particular manner of conducting the draft through the flues, and of governing it by dampers. The claim made is to "the constructing of a cooking stove with the fire place in the upper compartment thereof, and the oven, or ovens, beneath the fire, and having the flues arranged and regulated in the manner set forth." The former part of this claim, that to the locating the fire above the ovens, is very old, and it is therefore only in its combination with the flues, &c., that it could be sustained. The destruction of the models and drawings in the Patent office, is a circumstance very often favourable to applicants for patents, as some thousands of obsolete devices have been thereby removed, without a vestage of evidence remaining of their ever having existed. Many patents are passed in the office respecting which there is a firm conviction on the part of the examiners, that they are taken for what is really old; but where this conviction is not such as would amount to positive testimony in court, the application is not refused.

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400. For an improvement in *Door Springs;* Thomas Thorpe, West Cambridge, Middlesex county, Massachusetts, December 7. (See Specification.)

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401. For an improvement in the mode of *Forming Blocks for Printing Colours on Silk, Linen, &c.;* John Crabtree, city of New York, December 7.

The object in view is to obviate the difficulty arising from the shrinking of the blocks, or from other causes whereby the mitre joinings of the patterns are rendered imperfect. The angle pieces are made in a solid block, upon which the corner pattern is formed, with its mitre. The same blocks may contain other portions of the pattern, so that other pieces for filling up will complete it. The claim is to "the forming of the angle blocks in one piece; and to the general arrangement resulting therefrom."

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402. For an improved *Parlour Stove;* Jordan L. Mott, city of New York, December 7. (The Specification of this stove will appear in the succeeding number.)

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403. For *Water Proof Mail Carriages;* Basil B. Pleasants, Brookville, Montgomery county, Maryland, December 7.

The patentee says, "I make the body of the carriage, or wagon, cylindrical, or nearly so, and construct it of metal or of straight pieces of wood, or staves, which are bound together by strong hoops of iron. There is a strong head let in at each end of the cylinder, in the manner of barrel heads; and on the outside of these heads I form suitable receptacles for the way mails, and for the baggage of the passengers. On the upper part of the cylinder I make an opening which is provided with a door, properly secured by hinges on two sides thereof, and rendered water tight when

closed, by surrounding the edge of the opening with india rubber, or other suitable material prepared for that purpose, so that when pressed upon by the door every interstice will be closed, and the admission of water, or any moisture, prevented. The body of the cylinder is to contain the great mail in its transition from one distributing office to another." This cylinder is to be supported on a carriage, provided with thorough braces, and other means of hanging it. The door is made capable, by the double hinges, of being opened on either slide. A seat is proposed for three or four passengers, and it has a gig covering; below this, in front, is a seat for the driver. The claim is to "the constructing of the body of the wagon, or carriage, in a cylindrical form, and having a door opening into it as described; a receptable at the end for the way mail or baggage, and the seat for passengers combined therewith; the whole arranged substantially as set forth."

This was one of several devices brought forward in consequence of a proposition from the General Post Office, to give a premium for the most approved mail carriage. Of the plans offered this alone sought the sanction of a patent, and there the matter is likely to rest.

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404. For a method of *Preserving Iron and Steel from Oxidation*; M. Sorel, Paris, France, December 7. (See Specification, p. 52.)

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405. For an improved mode of *Colouring and Finishing Leather*; Harman Hibberd, Utica, Genesee county, New York, December 15.

Claim. "What I claim as my invention is the using of the ferro-prussiate of potash in forming a black on leather; and also using sulphuric acid and nitrate of copper in colouring vegetable oils and varnishes to be applied to leather, without an additional body which would diminish their tenacity or lustre; likewise the application of heat, with cylinders, in the finishing of leather in the manner described." There is much empirical matter in the specification of this patent, and from this cause we are deterred from affording space for the whole of it on our pages, as we much doubt its proving the means of advancing the chemical, or the mechanical, arts.

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406. For an improvement in the *Water Wheel*; Charles Goulding, Mobile, Alabama, December 15.

This wheel, we are informed, is "to be driven by water power in such a manner as that the whole pressure of the water in the fountain is constantly pressing on buckets, or valves, on the periphery of a revolving cylinder, without allowing any part of it to escape until it arrives at the issues in the sides of the machine, thus driving these buckets, or valves, and cylinder around." The particular construction is then described, and a claim made to "the whole in the manner described." The granting of the patent goes to show that this wheel was supposed to possess some novelty, but is no guarantee for its utility. We are of opinion that by giving a particular description of it, we should render no valuable service either to the inventor, or the public; the attempts to cheat water out of its natural powers and rights is one of daily occurrence.

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407. For an improved *Cooking Stove*; Horace Gleason, Boston, Massachusetts, December 15.

"My invention," says the patentee, "consists in constructing a com-

pact and portable apparatus having all the conveniencies for cooking, to fit into and be heated by a common cylinder or upright stove, to be removed therefrom at pleasure, and placed out of the way when not in use, while the stove remains to warm the room. Thus enabling small families, and those who wish to use economy in rent and fuel to cook in their parlours or sitting rooms without the encumbrance of a common cooking stove."

The apparatus which is the subject of this patent may be made in various forms, but in all of them it has an opening through its bottom and top admitting a cylinder stove to stand within it; the interior of the stove thus constituting a part of the sides of ovens, or other cooking compartments.

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408. For an improvement in the construction of *Boot Trees*; David Hastings, Deerfield, Franklin county, Massachusetts, December 15.

The centre, or slide piece of the ordinary boot tree, is to be divided down its middle into two parts, and these two parts are united by hinges. On each edge of the slide is fixed a plate of iron the whole length of the boot tree, and about three inches wide, curved so as to fit on to the two sides between which the slide passes. There are some other appendages, and a claim is made to "the slide divided longitudinally, and connected together with butts; and the iron plates attached to the said slides in the manner described."

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409. For a machine for *Thrashing Clover Seed*; Jonathan Brooks, Brownsburg, Rockbridge county, Virginia, December 15.

This machine has a cylinder and concave between which the clover seed is to be hulled, or thrashed out. The concave is composed of slats extending from end to end, and of strips of sole leather confined between the edges of the slats, and projecting inwards towards the cylinder. The cylinder is grooved along so as to form it into twenty, more or less, beaters, between which and the leather of the concave, the seed is to be rubbed out. The claim is to "the concave of strips of leather in combination with a cylinder having beaters, constructed substantially in the way described."

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410. For an improved *Machine for manufacturing Wood Screws*; Clement O. Reed, Providence, Rhode Island, December 15.

In this machine the blanks to be cut are held in a revolving wheel; their heads being held in clamps around its periphery, and their shanks projecting out on one face of the wheel, parallel to its axis. The manner of holding them firmly whilst they are being cut is by the pressure of a roller against the jaws of the clamps. The threads are cut by dies upon a mandril, having a guide screw. The claim is "to the manner of feeding the machine by fixing the blanks to a revolving wheel, and thereby carrying them to the proper position for cutting the screw without stopping the machine, as set forth." The general principle, or mode of action, of the revolving wheel is claimed, when employed in such a machine, without limiting the claim to the particular manner of holding the blanks.

A machine for cutting wood screws was patented by Henry Crum, on the 14th November, 1836, in which the screws are held in a revolving wheel; but in this machine they project out around the periphery of the wheel in a radical direction.

411. For *Manufacturing Artificial Stone*; Joseph Woodhull, Wheatland, Monroe county, New York, December 15.

The materials to be employed, are prepared plaster of Paris, quick lime ground to fine powder but not slaked, oxides of iron, and of manganese, calcined by a full red heat; and the kind of iron ore denominated poor ore, or whites, calcined and reduced to fine powder. The proportions to be used are five parts of the plaster, two of lime, one of manganese, one of whites, and four of sand, all estimated by measure. These materials are to be well mixed in the dry state, the whole is then to have sufficient water added to adapt it for being put into suitable moulds; when this is done, stones broken small are to be added, until the mould is full. In from twenty to forty minutes the moulded material may be removed. Variegated marble is to be imitated by using suitable colours, and proper manipulation. For in-door purposes the metallic oxides may be omitted; for outside work the material is to be saturated with linseed oil. The claim is to "the combining together Plaster of Paris, lime, the oxide of manganese, the description of iron ore denominated whites, and sand, all previously calcined, and the whole prepared and managed substantially in the manner set forth."

There will thus be made a very inferior kind of scagliola; an article when well compounded and managed, of great utility and beauty; which is what we dare not predicate of the compound above described. The validity of this patent admits of much doubt, as the combination can scarcely be denominated new, in any respect; at all events, the right extends only to the particular composition as given, and whilst there are many others which are better, equally cheap, and not covered by any special claim, it is apprehended that the right will be of little value to the owner, whilst it will not stand in the way of any one.

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412. For an Improvement in the *Horizontal Water Wheel*; Samuel Curtis, Eagle, Alleghany county, New York, December 15.

Claim.—"Making the horizontal conical water wheel on a perpendicular shaft, and placing the buckets on the sloped sides thereof, in the manner before described; also the use of a leather tapering tube at the end of the tapering trunk, serving as a gate, or valve, for regulating the column of water passing to the wheel, by means of a lever pressing on the same, in the manner before described; also the second described gate, or valve."

We are not disposed to give any further description of the above-named wheel, or of its appurtenances, not being able to furnish any valuable information respecting it.

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413. For Improvements in the *Circumferentor;* James Mc Cann, New Market, Shenandoah county, Virginia, December 20.

The claims made are—"1st, The addition to the compass-box of a Nonius plate for allowing for the variation of the needle; and the method of using the same. 2d. The slides and hooks for securing the sights in a perpendicular position to the bar. 3d. The addition of the sliding sight. 4th. The combination of the counter with the circumferentor."

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414. For Improvements in the construction of *Trunks and Valices;* Matthias Steiner, city of New York, December 20.

The claims made are—1st. To the uniting the top and bottom frames, or

lid and body of the trunk by a metallic hinge, extending the whole length of the trunk, said hinge being riveted to the frames. Strips of metal are also to extend around the ends and front of the trunk, at the place of the joint. 2d. To forming a channel, or groove, within the thickness of the under side of the top frame, to receive a corresponding tongue on the upper edge of the lower part. 3rd. To a mode of securing the trunk by means of a screw-rod, which passes through overlapping staples in the top and bottom parts, and is turned by a kind of screw-driver, and is thus made fast.

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415. For a *Spark Catcher;* William Duff, city of Baltimore, December 20.

The smoke pipe of a locomotive engine is to have a cap somewhat in the form of a sugar loaf; its sides are to consist of a number of slats standing one above another, like the slats of a venetian blind, at an angle of about 45°. This slope is to throw the sparks downwards as they escape from the chimney, which is surrounded by a second cylinder, a small distance from it, allowing space for a receptacle. This outer cylinder flares out at top, and is covered by a cap of wire-gauze. The inside of the flaring part of the jacket has straps of metal around it, arranged also in the manner of blind slats, to arrest any sparks which might tend to ascend.

"I claim the venetian screen made so as to cover the smoke pipe, and throw the sparks downwards; also the application of the strips on the inside of the top of the jacket, which prevent any substances from passing up the sides of the jacket; all applicable to locomotive engines to arrest sparks and extinguish them, and to cause a draft in the chimney; and the application to ordinary chimneys to cure smoking, and to produce a draft in them."

That a draft will be caused by such a contrivance is rather a novel idea; but if it will do this, and cure smokey chimneys, it might be worth while to put several upon some chimneys, to insure success.

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416. For an improved *Floating Dry Dock;* John Thomas, city of New York, December 20.

Claim.—"Having thus fully described the construction of my Floating Dry Dock, and the manner of using the same, I do hereby declare that I do not claim as my invention either of the separate parts thereof, taken individually; nor do I claim the application of floats or trunks from which water is to be pumped out for the purpose of lifting vessels for repair, this having frequently been done; but what I do claim is the making and using the smaller, or end trunks, or floats, which are to be used in combination with the main floats, and are not to admit water, but are to be forced down as the dock with its load rises; the whole combined and operating substantially in the manner, and for the purpose herein set forth."

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417. For an improvement in the mode of constructing *Force and Suction Pumps;* Jonathan Stevens, Newark, N. Jersey, December 20.

There is a peculiarity in the manner of arranging two side pipes, with their valves, alongside of a metallic cylinder, and the claim relates, and is confined, to this arrangement, which does not present any thing new in principle, or which can be advantageously applied to pumps in general.

418. For *Machinery for Spinning Tobacco;* Hiram M. Smith, Richmond, Virginia, December 20.

"My invention consists in the application of what is usually denominated a clutch, to the end of the common spool used in spinning tobacco, to be removed whenever its motion is required to be checked or stopped; and in providing a friction lever, and making the same in combination with the lever and with the clutch; thereby enabling the spinner, at any point in the spinning table, by the single operation of sliding a small rod, which may be done with the thumb and finger, to remove the clutch and apply the friction lever to the end of the spool, and by this means prevent the spool from continuing to revolve after the clutch is removed, which it would otherwise do for some length of time, from the momemtum given it in spinning," &c. &c. The claim is to the combination of the clutch, the friction lever, and the spool, in the manner described.

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419. For a Machine for *Hulling Clover Seed;* William M. Barton, Cheek's Cross Roads, Hawkins county, Tennessee, December 20.

A wooden disk is to be placed on the upper end of a vertical shaft, and is to have its upper surface furrowed like a mill stone; this constitutes the runner. Above it is a platform of wood, supported on a frame like a table top. The under side of this platform is to be furrowed like the runner. There is a hole in the centre of a platform, which is surmounted by a hopper for feeding the seed to be hulled. Means are provided for causing the runner to revolve; and also for regulating its distance from the platform. This constitutes the whole machine. The claim is to the "making the runner and cap out of wood, and furrowed in the manner above described."

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420. For a Machine for *clearing Burrs from Wool, in the skin;* Erastus Tracey, Poughkeepsie, Dutchess county, December 20.

The skins with the wool on, as imported from South America, are filled with burrs from which it has hitherto been found difficult and expensive to remove them, but with this machine it is said to be readily and perfectly affected. A cylinder is made about two feet in length, and one foot in breadth, and upon this are placed several rows of steel teeth, about an inch long, and an eighth of an inch apart. This cylinder is made to revolve with great rapidity, and the skins are fed up to it by means of a feeding apron passing around rollers, one of which is nearly in contact with the revolving cylinder, and has above it a pressing roller, to hold the skin firmly. The endless apron, with its appertenances, is on a separate frame, which is made to approach, or recede from, the revolving cylinder by means of a rack and pinion. The skin is laid on the revolving apron, and carried forward so that one-half of it hangs down from beneath the pressing roller; it is then moved up so as to be acted upon by the revolving cylinder, and drawn back on the revolving apron, until the first half has been cleaned. The skin is then turned end for end, and the operation completed. The claim is to "a machine having a revolving cylinder furnished with teeth to which the skin, placed upon an endless apron is fed up, and operated upon, as herein set forth."

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421. For an improved *Machine for Sawing Staves;* Harvey Holmes, New Marlborough, Massachusetts, December 20.

This machine is to cut the staves lengthwise of the grain of the wood.

For this purpose, a wheel, the circumference of which has the curvature of the stave, is to be fixed on a vertical shaft, and made to revolve by any adequate power. Steel teeth are to be fixed around the periphery of this wheel, and are to project downwards below its lower edge, and they are to be curved in their length in such manner as to adapt them to the curvature of the stave widthwise. This constitutes the saw. The stuff is to be fed up to this by suitable apparatus below. Instead of making a perfect wheel, it is proposed sometimes to make segments only, for cutting the staves.

"What I claim as my invention, is the construction and use of a wheel, or segment, or segments thereof, which wheel, or segment, shall have a radius the same, or nearly the same, with that of the stave to be cut, taken longitudinally; said wheel having teeth on its periphery, which are to be bent lengthwise, so as to cut such stave to the proper curvature transversely."

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422. For an Improvement in the *Cooking Stove;* James Hutchinson, Jr., Lynn, Essex County, Massachusetts, December 20.

The claim refers only to a special arrangement of the dampers and flues, which was viewed as sufficiently novel to pass examination, but which is not of a character to justify a long story.

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423. For an Improvement in *Secret Safety Locks;* William Hobbs, Springfield, Hampden county, Massachusetts, December 20.

This is a contrivance intended to be used, principally, on hasp locks for trunks; it consists in a particular manner of shifting the hasp laterally, and of managing the key in turning it; the device is ingenious, and one which may serve to please the curious, and to induce the sale of a number of trunks; but we do not think it necessary to employ the engraver to represent it.

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424. For an Improvement in the *Thrashing Machine;* Alexander W. Bowling, Front Royal, Warren county, Virginia, December 20.

The principal improvement claimed in this machine is in the mode of putting the parts together, and of holding them firmly in place; a point of very great importance, and which is not sufficiently attended to in most of these instruments. The centrifugal force arising from the very rapid revolution of a thrashing cylinder, has occasioned much maiming, and, in several instances, loss of life. The mode of construction here proposed, is well calculated to insure strength. There are some minor points in this machine which are claimed as improvements.

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425. For Improvements in the *Machine for Grinding Grain;* Oliver Wyman, East Cambridge, Massachusetts; originally patented July 1, 1836. December 20.

The runner of this grist mill is in the form of a frustrum of a cone, with the base downward, and this is enclosed within the stationary stone, which consists of two parts confined together by screws. The runner, as described in the first patent, had a bridge tree below it, upon which the spindle rested. In the improved form, the stone is suspended by the spindle from a bridge tree above it, the spindle being jointed to allow it to play, and having a collet on it which rests in a cup on the upper surface of the bridge tree. The claim made is to the "suspending the runner of the patented mill, from a bridge-tree above the stone, by means of the combination described of rings, key, and pin, by which the runner can accommodate itself to the bed in the most exact manner."

426. For an Improvement in the *Machine for cutting Dyewood and Bark;* Abner McMillen, Bedford, Hillsborough county, N. Hampshire, December 26.

The patentee says, "I am aware that dyewoods have been reduced by circular saws, and other machinery operating on the end of the stick, applied in various ways, but what I claim as my invention, and consider as new in the above described machinery is the construction of the carriage in combination with a cylinder of cutters and a depressing roller, constructed and operated substantially as herein described."

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427. For an Improvement on the *Truss for Hernia*; Josiah Hungerford, Dover, Dutchess county, New York, December 26.

The claim is to a particular mode of reversing the pad, by means of oblique mortises; the mode of connecting the pad to the spring, and of adjusting it in its place. There is but little novelty in the contrivance, and nothing to render this superior to many other trusses.

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428. For an Improved *Steam Generator;* William Creed, Boston, Massachusetts, December 26.

This is a vertical, tubular boiler, the outer case of which is a double cylinder, with water between them. The tubes above the furnace rise vertically and terminate in a drum from which the smoke pipe issues. The claim is to the "constructing two or more tubes in sets, of one piece, uniting at their upper end in a common orifice, where they are connected with a drum terminating in a smoke pipe; the whole being constructed, combined, and arranged substantially in the manner described."

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429. For an Improvement in the *Safety Rail Road Car;* William Kinkead, Elkton, Cecil county, Maryland, December 26.

The claims are to a "method of sustaining the car in case of the breaking of the wheels, axles, &c. in the manner described. And to the manner of constructing the safety hooks with joints or hinges, screw rod and nut, so that said nut can be engaged with, or disengaged from, the centre guide bar, or safety rail, with great facility and despatch, in case of any trivial accident which might arrest the progress of the cars, or in case it might be desired to turn out of the main track."

This is an *improvement* in rail roads such as is frequently devised in the parlour, but which never finds its way on to the track, and which, were it placed there, would prove to be but a transient lodger. A third rail is to be laid in the centre between the ordinary rails, and is to extend up nearly to the bottom of the cars; there is to be a plate on this rail, forming it into a T rail, and from the bottom of the car hooked pieces are to descend, and clip under the top of the said T plate. Rods reaching into the car act upon and withdraw these hooks, when necessary. Should a wheel, &c., break, the car is to rest on the centre rail, and should the car tend to leave the track, the hooks and safety rail are to prevent it.

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430. For a *Ready Binder for binding Newspapers, Sheets of Music, Letters, &c.;* Ezra Ripley, Troy, Rensalaer county, N. York, December 26.

There are two flat pieces of wood, like flat rulers, which are to hold the back edges of the sheets between them. These are acted upon by springs,

simply and ingeniously arranged, so as to produce the desired effect in a very perfect manner. To give a clear idea of the arrangement of the springs, &c. would require a drawing.

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431. For Improvements in *Fastenings for Window Blinds and Shutters*; Elijah Jaquith, Brattleborough, Windham county, Vermont, December 26.

These fastenings are of very doubtful originality, as a number of devices for the same purpose have been patented; a hundred modes of making them, probably, had been the subject of patents, and were removed out of the way of re-inventors by the burning of the office. In its general form, and mode of action, the present fastening does not differ from others, long in use; the only claim made being to the form of the spring which acts upon the catch, which spring is coiled and inserted, like that used in common snuffers; so far as appeared in the office, this was a new combination in the blind fastening.

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432. For an Improved *Separating Link for connecting Rail Road Cars*; C. H. Hunt, and W. Brown, Fredericksburg, Virginia, December 26.

The principal object in view in the construction of this link is, "in case of the engine, or a car of the train, being thrown off the track, for becoming instantaneously disengaged, leaving the remaining portion of the train on the track." The instrument appears likely to answer the intended purpose, and therefore, in some instances, to be of utility; it rarely happens, however, that in the case of a locomotive, or a car, leaving the track, it will itself be removed out of the way of those behind it.

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433. For an Improved *Standard Measure for taking measure for Coats*; Erastus Barber, Boston, Massachusetts, December 26.

This instrument is more simple in its construction than most of those which have been devised for the same purpose, and from this cause, appears to us better adapted to the intended use; in venturing such an opinion, however, it ought to be confessed that it relates to a matter in which we have no learning, and but little judgment. The claim is to "the above described standard measurer constructed so that all the points required in the fitting of the body are obtained from one vertical line, as set forth. Also the fixing the standard measurer firmly in its place by means of straps, or otherwise, thus insuring correctness in operation, notwithstanding the moving about of the person who is being measured."

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434. For an Improvement in the construction of *Locomotive Engines;* Samuel Wright, Philadelphia, December 26.

We expect to obtain a cut of the improved locomotive, which, when ready, will be given with the specification.

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435. For an Improved *Sliding Flue Grate*; Daniel Desmond, city of New York, December 29.

The claim made is to "the drawing out of the flue with the grate, so as to preserve an equally good draught, and yet adapt the grate to the purpose of cooking, or giving out heat into the room."

An open grate is set in a fire place so that it may remain flush with the

front, in the usual manner. Above it is a stationary oven, around the bottom, back, and top of which the flue passes, there being doors in front opening into the oven. The grate may be drawn out, and project far enough from the oven to have boilers placed in openings directly above the fire. A sliding flue is attached to the grate, and passes into that under the oven, preserving the continuity of the draught, whether the grate be shoved in, or drawn out.

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436. For Improvements in the Machine for *Thrashing and Cleaning Grain;* J. A. and H. A. Pitts, Winthrop, Kennebec county, Maine, December 29.

This machine is constructed in the thrashing part like many others; it is combined with a winnowing machine, as has repeatedly been done, and the things claimed are certain special matters and the mode of combining them.

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437. For an Improvement in the *Cooking Stove*; Carrington Wilson, city of New York, December 29.

The claim is to "the plan of carrying the flues up the remote corners of the body of the stove by diagonal plates, and the arrangement, so far as connected with this object, by which the stove is rendered much more compact, and the dimensions of the oven proportionably enlarged."

It will be seen from the foregoing that the only novelty claimed is in the peculiar form given to certain parts of the stove.

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438. For an Improvement in the mode of making *Harness from metallic Heddles, for Weaving*; B. Hartford and W. B. Tilton, Enfield, Grafton county, New Hampshire, December 29.

Instead of the cord usually employed in making the harness, it is to be composed of strips of metal, with eyes made through them for the passage of the yarn.

"What we claim as our invention and desire to secure by letters patent, is, first, the above metallic heddles, formed in one entire piece, with holes therein to admit the weft, and for their support upon the rods, as above described. These heddles are made of tin, or of wire that has passed between rollers to give it the required width and thickness. Second, we claim the heddles with holes fitting closely to the rods on which the heddles are placed. We claim the heddle frame, constructed substantially as described." The rods above referred to are two parallel rods of round iron at the top and bottom of the harness frame, the metallic heddles having holes at each end by which they are connected to the rods.

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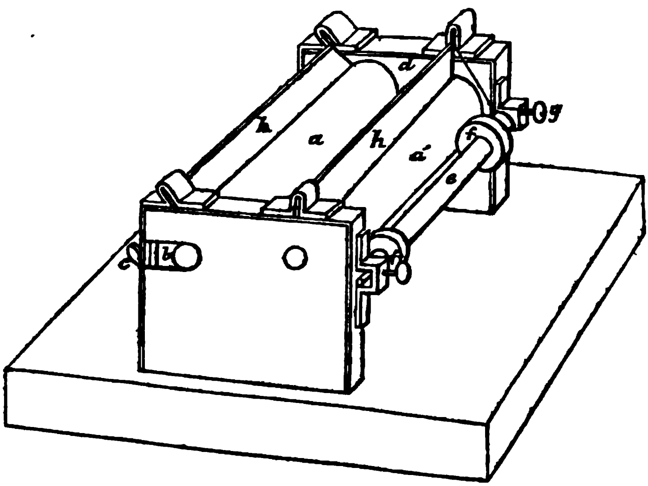
439. For *Fastenings for Saddle Bags, Mail Bags, &c.*; Alvin North, New Britain, Hartford county, Connecticut, December 29.

The claim is to the method described of making the hasps of saddle bag fastenings, and other articles. This is a very trifling affair, and it would be a difficult task to place its merits on record.

Specifications of American Patents.

Specification of a patent for a machine for sizing paper; granted to John Ames, Jr., *Springfield, Hampden county, Massachusetts, December* 1*st*, 1837.

To all persons whom it may concern, be it known, that I, John Ames, of Springfield, in the county of Hampden, and Commonwealth of Massachusetts, have invented a new and useful improvement in the method of sizing paper by machinery, called a sizing machine, of which the following is a full and exact description.



At a convenient height, I place two cylinders in a horizontal position, and parallel to each other, turning on their respective axes. See, *a*, *a'* in the drawing. I make one cylinder, *a*, of metal, about five and a half feet long, and about nine inches diameter, with a polished surface—the other *a'* of wood, of the same length, but of a diameter sufficient to keep it from springing; and consequently, the diameters of the cylinders may vary in due proportion to their length in all cases. One of the cylinders rests on movable boxes, *b*, which are regulated by screws *c*, or levers, which are so adjusted as to carry the cylinder that they act upon into close contact with the other cylinder when operating.

The paper is brought in a continuous sheet from the paper machine, over a cylinder whose axis is parallel to the axes of the other cylinders, and which is elevated above the others, and so placed that the sheet descending perpendicularly, passes between the first named parallel cylinders—the motion of the cylinders being such as to carry down the paper between them.

That part of the descending surface of each cylinder above their line of contact forms with the descending sheet a trough for the sizing. The ends of the sizing cylinders run against a flat surface, *d*, making a joint close enough to prevent the escape of the sizing.

These troughs are filled, or nearly so, with the sizing prepared in the usual way.

In order to keep up the supply in the troughs, I place a vat, or cistern, containing the sizing in a position higher than the sizing cylinders, having tubes, discharging the requisite quantity into the troughs. Beneath the sizing cylinders, is placed a trough to receive the sizing that passes down between the cylinders at places not in close contact, and it is pumped back into the upper trough, or into the cistern.

By means of the dripping, the edges of the sheet are sometimes, especially in cold weather, apt to be smeared by the sizing. To prevent this I put a strip of fine linen or thin silk around the wooden cylinder *a'*, (when one is used) where the edges of the sheet pass.

These strips serve to make a closer joint, and prevent the escape of any sizing near enough to touch the edges, after passing and being pressed between the cylinders.

If metal cylinders are used, in order to obviate the same difficulty, I place near to the outer surface of the cylinder, which leads off the paper from the sizing machine, and corresponding to its axis, a shaft, *e*, on which are placed wheels, *f*, *f*, with rims two, or three, inches wide.

This shaft is regulated by screws, *g*, or by a lever. The rims of the wheels, which are placed so as to correspond with the edges of the sheet, are pressed with proper force against the cylinder, which turns them by the friction. The edges of the paper are thus pressed and freed from the sizing that may have attached to them.

To clear the cylinders and enable them to present a smooth surface to the sheet, I place upon each a scraper, *h*, *h*, called a "doctor," made of a strip of wood of the length of the cylinder, with an edge of about half an inch thick, covered with cloth. The edges of the doctors are pressed upon the cylinders with force sufficient to scrape off any scurf that may adhere.

What I claim as new and as my invention is the combination of the several parts of the above described machine, in the manner specified, for the purpose of sizing paper without the use of felting, or jackets.

JOHN AMES.

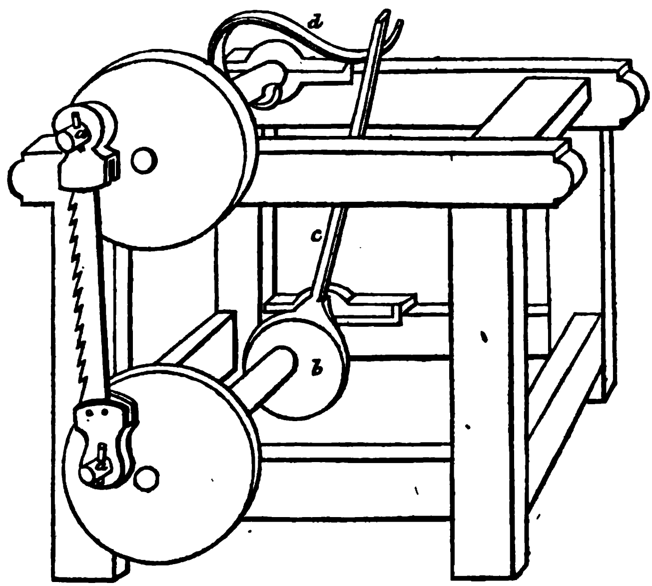
Specification of a Patent for Improvements in the mode of constructing Saw Mills; granted to JOHN AMBLER, Jr., *city of Philadelphia, December* 1*st*, 1837.

To all whom it may concern, be it known, that I, John Ambler, Jr., of the city of Philadelphia, and state of Pennsylvania, have invented a new and improved mode of constructing Mills for sawing timber; and I do hereby declare the following is a full and exact description thereof.

Instead of hanging my saw by means of a frame and fender posts, or by means of vibrating levers arranged in any of the various ways heretofore practised, I provide two shafts which are placed in a suitable frame, one over the other, and at such distance apart as shall correspond with the length of the saw to be used; and on one or both ends of these shafts, I form cranks, to which the two ends of the saw, or saws, are to be attached by means of metal blocks affixed on each end of the saw, said blocks having sockets to receive the ends of the cranks.

The accompanying drawing represents such a view of my mill as will serve fully to illustrate the construction and operation thereof. The cranks

a, a, are shown as connected to revolving, or vibrating, disks, or wheels, but they may, instead of wheels, be simple cranks, of the ordinary form.



The crank pins may each be at equal distance from the centre of their shafts; in which case, both of the crank shafts are intended to make a complete revolution at every stroke; the length, or throw-out, of each crank should, in this case, be about four inches, but it may be more or less; it being intended, however, in my mill, always to feed, or cut, less at each stroke than with the ordinary mill saw, and to give a more rapid motion thereto.

I do not intend, in general, to make both the cranks of one length, but to give a throw-out to the upper, of from five to eight inches, and to the lower, from three to six inches; the consequence of which will be that when the lower shaft is made to revolve by the application of any suitable power, the upper will vibrate backward and forward, performing a part of a revolution only, the extent of which will be determined by the relative lengths of the cranks. To keep the saw on a strain, I fix a spring, or a weight, so that it shall act upon the shaft of the upper crank, so as to draw it round from the saw. A spring is to be preferred to a weight, in this case, as any desired degree of tension may be given to it.

The spring may be fixed in various ways, so as to produce the desired action, but in all cases it should be so connected and arranged as that the greatest tension should be given to the saw at the period when it is rising. One method of effecting this is shown in the drawing.

An eccentric, *b*, is placed upon the lower shaft, and surrounded by a hoop, from which the rod, *c*, ascends, which rod is attached to the outer end of a coiled, or curved, spring, *d*, the inner end of which is fastened to the upper shaft.

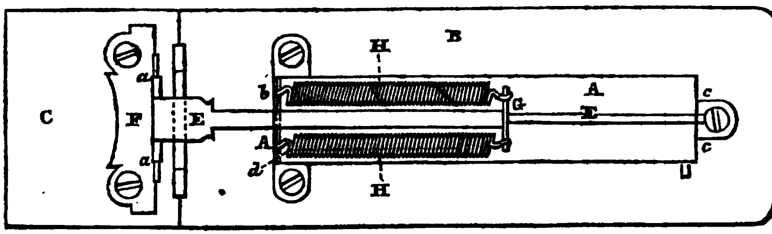
What I claim as my invention, is the hanging of Saw Mill Saws upon rotating, or vibrating, cranks, substantially in the manner herein described.

JOHN AMBLER.

Specification of a patent for an improvement in Door Springs; granted to Thomas Thorpe, *West Cambridge, Middlesex county, Massachusetts, December 7th*, 1837.

To all persons to whom these presents shall come, Thomas Thorpe, of West Cambridge, county of Middlesex, and State of Massachusetts, sends greeting.

Be it known that I, the said Thomas Therpe, have invented a new and useful improvement in door springs. The said improvement, the principle thereof, and the modes in which I have contemplated the application of the same, together with such parts, combinations, or characteristics, by which it may be distinguished from other inventions, and which I claim, I have fully set forth in the following specification and drawings referred to therein.



A, A, represents the outer casing of brass, or other suitable metal, shaped as seen in the drawing, or otherwise properly formed.

B, is the door on which the spring is to be fastened; C, the door frame.

E, is a metallic rod, turning on a hinge at *a*, in the side of the piece of metal F, screwed to the door frame. The rod E, passes through holes in the ends, *b*, *c*, of the casing A, moving freely back and forth in said holes. G, is a cross bar attached to the rod E, in a proper manner, and has connected to each extremity the end of a wound spring, H, H, whose opposite end is confined to the end *b*, of the casing, or to a pin *d*, passing through the sides thereof.

When the door is opened, the springs H, H, are extended by the movement of rod E, through the slots in the ends *b*, *c*, of the casing, and in withdrawing the force applied to open the door, the springs contract, and immediately close the same. Instead of two springs, I may use only one, or I may employ three, or more, should it be deemed advisable.

The main advantage of this spring consists in the exertion of a strong force to close the door, when nearly shut. Other kinds of door springs generally fail in this part of their operation.

I claim as my improvement, the above arrangement of springs, acting on a rod E, and operating in the manner above described.

Thomas Thorpe.

Specification of a patent for manufacturing Boots and Shoes of India Rubber; granted to Stephen C. Smith, *city of New York, December 7th*, 1837.

To all whom it may concern, be it known that I, Stephen C. Smith, of

New York, in the county of New York, and State of New York, have invented a new and improved mode of manufacturing boots and shoes of sheet india rubber, and I do hereby declare that the following is a full and exact description of the process of manufacture.

A cloth, or leather, lining is fitted to the last, and sewed, or cemented, to an insole of leather; over this are then spread with a brush, two or three coats of dissolved india rubber, to render it sticky; the sheet rubber is then cut into the proper shape, and two or three coats of dissolved india rubber spread on one side of it; the sheet rubber is then put on to the cloth lining and rubbed down; the cement on it causes it to adhere to the cloth, a sole of leather, or of india rubber, is then cemented to the bottom—the boot, or shoe is then taken from the last, bound round the top, blacked, and is ready for use.

What I claim as my invention, and desire to secure by Letters Patent, is the making of Boots, Bootees, Shoes, Overshoes, and Slippers, of sheet india rubber, in the manner herein described.

STEPHEN C. SMITH.

English Patents.

Specification of a patent granted to NATHANIEL PARTRIDGE, *county of Gloucester, for his invention of a certain improvement or certain improvements in mixing and preparing oil paints, whereby a saving of ingredients commonly used will be effected.*—[Sealed 8th December, 1836.]

This invention of a certain improvement or certain improvements in mixing and preparing oil paints, whereby a saving of ingredients commonly used will be effected, consists in the application and use of solutions of lime in water, in the mixing and preparing of oil paints, for the purpose of thickening or preparing the oils used in the same, and forming a better vehicle for the various pigments or paints, and at the same time producing economy in the various ingredients commonly used in the mixing and preparing such paints, (that is to say) instead of using oil only in the customary manner as a vehicle for the various pigments or paints, I first saturate rain, soft, or distilled water with lime, and when in a pure state of solution, that is, after that portion of lime which the water will not take up has subsided, and the water remains clear, it will be fit for use.

For preparing paints for the useful arts, I first mix the said lime water with oil in about equal parts or proportions, by placing the same in a proper vessel, and agitating them till they are united or commixed, in which state the combined oil and lime water will resemble thick cream, in consistency. To about two parts of this composition of lime water and oil I add about four parts of ground white lead, by mixing and preparing them in the usual manner. Should the paint made with this proportion of the composition be found too thick, it may be reduced or thinned by adding small portions of oil, when spirit of turpentine is not mixed therewith, as in paint used for out-door work. But when turpentine is used as for in-door work, the paint may be reduced or thinned with turpentine, only without the addition of any further quantity of oil.

For what is called by the painters flatting the works, or for the last coat put on, I mix about four or five parts of the composition of oil and lime

water, with about eight parts of spirits of turpentine, and add thereto as much ground white lead as the workmen may think necessary in order to make the paint for the last or flatting coat of the proper consistency.

I may here remark, that this flatting coat will not only be put on with less trouble, but will also be found more perfect and durable than when turpentine alone is used. Should the workman wish to lay on a thicker coat of paint, he may add more white lead. For wall painting, the walls should be oiled over before the paint is put on. It may be observed, generally, that in all cases where turpentine or dryers are used with this composition of lime water and oil, a less proportion of them is necessary than when oil alone is used; and that if sugar of lead be used as a dryer, it may be dissolved in the lime water before being mixed with oil, when being in a state of pure solution, it will be found advantageous to the colours.

It is proper to notice that Prussian blue, and some of the dry absorbent earths, such as ochres, umbers, or any other colour that may be found not to grind well in the composition, ought to be first ground in equal parts of raw and boiled linseed oil, or boiled linseed oil only, as may be required, to about the thickness of white lead, as usually prepared, and then to be mixed up for painting with the composition. And further, that I have found the following to be a convenient manner of preparing the solution of lime water; that is to say, to about twenty gallons of cold soft water (or if it be distilled the better,) apply three or four pounds of fresh burnt lime, put them into a cask, stir it well about, and let it stand about twenty-four hours, or until the water is quite clear, when it may be drawn off as wanted; it should be stirred up every six or seven days, that the water may be kept fully impregnated with the lime; and that a convenient mode of mixing the lime water with the oil, is by placing the proper proportion in an open vessel, as a tub or bucket, and whisking or beating them well together; or place the same in a bottle or jar and shake them together until completely blended; and further, I would remark, that the mixture of lime water and oil should always be well shaken before being mixed with the pigments: the lime water should be kept from the air, and as cool as possible.

For preparing my improved paints for the fine arts, the colour should be ground in such proportions of oil and lime water, as may be found requisite, as the exact proportions cannot be stated, as they vary according to the nature and quality of the materials used; but it is desirable to incorporate as much lime water as possible, in order to render the paints crisp, or short, to the touch, and transparent. When sugar of lead is used as a dryer, I dissolve it in the lime water, which I consider an improvement.

For preparing a composition, or what is called by artists "maguelph," for the purpose of thinning the paints or colours on the pallet, I mix the lime water and oil together, and then add a little mastic varnish; the more lime water which can be incorporated, the thicker and crisper, or shorter, will be the composition.

Having now fully, and particularly, described the nature of my said improvements, and the manner of carrying the same into effect, I wish it to be understood that what I claim as my invention, and secured to me by the above in part recited Letters Patent, is the application and use of solutions of lime in water, or a composition of lime water and oil, in the mixing and preparing of oil paints for the useful and fine arts severally, such invention being new, and never before used within these kingdoms, to my knowledge or belief.—(*Inrolled in the Rolls Chapel Office, June,* 1837.)

Journ.. of Arts & Sci.

Specification of a Patent granted to Webster Flockton, *of the county of Surrey, for improvements in Preserving Timber from Decay.*—Sealed August 3, 1837.

To all to whom these presents shall come, &c. &c.—*Now know ye*, that in compliance with the said proviso, I, the said Webster Flockton, do hereby declare the nature of my said invention, and the manner in which the same is to be performed, are fully described and ascertained in and by the following statement thereof (that is to say:—)

My invention consists in impregnating timber of various descriptions with a metallic solution, whereby such timber will be preserved.

And I produce the necessary solution in the following manner, which I consider the best and cheapest means of carrying my invention into effect, though I do not confine myself to the precise means hereafter described, as variations may be made; my object being to impregnate timber for any purpose, it may be found applicable with a metallic oxide, as above stated, and as is more fully described hereafter.

In order that my invention may be fully understood and carried into effect, I will describe the method I pursue of combining materials together and applying them to the purpose aforesaid. I take a quantity of tar (either Stockholm, Archangel, or American) which I submit to the process of distillation; and the apparatus, or still, which I use for this purpose is similar to what is called a pitch still, which is made of copper, and is well known, and forms no part of my invention, nor does the process of distillation for separating the essential oil from the tar, which is effected in the manner following. The still which I use will contain about four hundred gallons, but I do not put into it more than three quarters of that quantity of tar of either of the kinds before mentioned. The first product will be the acid of the tar, bringing with it a light coloured essential oil, which separates immediately and floats upon the surface of the acid in the receiver, which I prefer of wood (a cask with one head and furnished with a cock for withdrawing the acid from below being applicable to the purpose.) After some time the acid will cease and the essential oil will come over in a very considerable stream, which I collect from the receiver to the extent of about forty-eight gallons in the whole, including that which came over in the first instance with the acid. The fire is then to be withdrawn and the contents of the still, which by the extraction of the essential oil, has become pitch, allowed to remain in the still until the following morning to cool, when it may be let off by means of a pipe fitted with a brass or iron plug into a large receiver of cast-iron or other suitable material, and finally put into casks for sale.

I will now proceed to describe the combining of the essential oil with the other materials for the making of my "metallic solution." To effect this, I place two or more large casks upright, removing the upper head of each, and throw into them well rusted iron hoops or tin cuttings. I then pump into them one hundred gallons or more, according to the size of the casks, of the essential oil of tar before described, completely covering the metal. This oil I cause to be repeatedly pumped every day from one cask to the other for about six weeks, by which time the oil will have become very black and much increased in gravity, whilst the iron hoops or tin cuttings will appear quite bright and free from oxide. They are then to be taken out and piled up in an open space of ground and set fire to for the purpose of burning off the oil, and afterwards laid by for re-oxidation,

which may be much facilitated by pouring over them a weak solution of common salt and water. When they have been rusted they will be fit for use.

I will now proceed to describe the method I pursue of saturating timber with the metallic oxide. For saturating wooden piles already driven into the sea, forming jetties or piers, I cause an inch auger to be passed down the centre of the piles to the bottom end if possible, or as far down as can conveniently be done, and the "metallic solution" poured down the hole until filled. This is to be repeated as often as may be thought necessary, but generally in a day or two, it will be found oozing through the pores of the wood depositing an incrustation of iron, which, in combination with the essential oil of the tar, resists alike the action of the water, and the attacks of the worm. A wooden plug or tree-nail is to be driven fast into the hole which may be removed by the auger at any time for the purpose of giving the piles a fresh supply. This method is likewise applicable to the wooden sleepers of railways, and in short to all timber, subject to damp or moisture or the attacks of worm or other vermin.

For out-door buildings, liable to dry rot, it is to be used cold, in the usual way of tar or varnish, with a brush; for being perfectly liquid, it penetrates most rapidly, drying completely in eight or ten hours, when a second dose may be given. Applied to the framing and joists of houses they will be effectually preserved from decay, or where dry rot has in any shape made its appearance, so as to be within reach of applying the solution, perfect soundness will be restored to the infected timbers with a total extermination of fungus.

Having thus described the nature of my invention, and the means of carrying the same into effect, I would have it understood that I lay no claim to any of the materials separately, and it will be evident that the means of carrying the same into effect may be varied to suit the particular object to which the invention is to be applied. But I would have it understood that what I claim, is the impregnating timber of various descriptions with a metallic solution (such as I have described) whereby such timber may be preserved.—In witness whereof, &c.

Enrolled February 3, 1838. Repor. of Pat. Inven.

Specification of a Patent granted to Robert Whitfield, *of the county of Surrey, for a composition which he denominates an indelible, safety, and durable black fluid writing ink.*—[Sealed 14th November, 1837.

This invention merely consists in combining a very long list of ingredients in different proportions, most of which are highly combustible, and then setting them on fire by means of a red-hot iron rod, and collecting that portion of them which in the act of combustion would otherwise escape in the state of smoke, and become soot, and also collecting the residuum of the burning operation which is afterwards to be ground up into an impalpable powder, and when mixed with some liquid ingredients, hereafter named, will produce a fine indelible black ink, which the Patentee informs us cannot be extracted from paper, parchment, &c. by any acids or chemical processes whatever, without materially injuring the texture of the material subjected to such a process.

The principal ingredients employed by the Patentee in making the beforementioned mixture to be subjected to combustion, are the following, and

they are mixed or amalgamated in various proportions; viz. linseed oil, cocoa-nut oil, Venice turpentine, bullock's blood, loaf sugar, seed-lac, gum arabic finely pounded, linseed and pounded cotton seed, finely purverized charcoal, pomegranate peel, Aleppo nuts, gum kino, solution of India rubber, the very best molasses, or treacle, parchment shavings, ocre seed, burnt horns, the best ivory black and Antwerp black, tartar, Indian borax, cyanuret of potash, a quantity of the best glue finely pounded, Arcadian nuts, and walnut shells. These materials are intimately mixed together in a large iron vessel, and boiled for about ten minutes; the whole mixture is then set on fire by stirring it about with a red-hot iron, and allowed to burn till all the oil is consumed. The smoke arising from the combustion of this mixture is collected in a conical-shaped vessel, which is inverted over it; this vessel is to be made of the very best sheet iron; it will then be found that the smoke will become condensed, and deposit itself in the shape of soot on the side of the conical vessel: and when all the oil is consumed by the combustion, the product, or that which is found in the conical vessel, must be carefully collected, and put into jars; and that part of the ingredients which remains in the iron boiler, or caldron, and which will be found adhering to the sides of the vessel, must be scraped off, and ground upon a stone until it becomes an impalpable powder.

The products thus obtained must be mixed with some liquid materials in about the following proportions:—to one pound of the products above-mentioned, add one quart of the very best French vinegar to about one gallon of hot water, a small quantity of finely powdered gum arabic, and an equal quantity of gum lac; to these must be added a few Aleppo galls, and a small quantity of logwood chippings. The whole of this must be boiled for about ten minutes in an iron vessel, and then poured out into shallow iron vessels, and be allowed to remain for three weeks exposed to the atmosphere.

The patentee says, in conclusion, "I do not mean or intend to claim the exclusive use of any of the materials herein set forth, nor do I intend to confine myself to the exact proportions of combining them, as the same may be beneficially varied; but what I claim as my invention, is the producing an indelible black ink from the products above named, or from the greater proportion of them combined with the liquid ingredients, as above described."*

Jour. Arts & Sciences.

Specification of a Patent granted to EDMUND SHAW, *of the city of London. Stationer, for an Improvement in the Manufacture of Paper, by the application of a certain vegetable substance not hitherto used for that purpose.*—[Sealed September 14, 1837.]

To all to whom these presents shall come, &c. &c.,—*Now know ye*, that in compliance with the said proviso, I, the said Edmund Shaw, do hereby declare the nature of the said invention, and the manner in which the same is to be performed, are fully described and ascertained in and by the following statement thereof (that is to say):—

I take the envelopes or leaves which cover the ears of Indian corn, and put them into a vessel containing water. The water may be pure, or slightly alkaline, or acid; I then boil the water in the vessel, either by steam or

* The above patent is extracted mainly as a matter of curiosity and absurdity.

fire heat, and macerate the aforesaid envelopes or ollicular leaves. When they have imbibed water and become thickened and swollen, so that the matter interposed between the fibres is reduced to a state of pulp or jelly, a slight beating by a fulling mallet, or other mechanical means, will effect a separation of the fibre from the adherent glutinous matter, and washing or rincing with water during the beating, will cleanse it entirely from the glutinous matter.

I bleach the fibre produced as above, by immersing, or immersing and beating or stirring it about in a solution of chloride of lime, or with beating engines, as it is at present practised for the bleaching of rags in paper mills, and the fibre is in like manner reduced to a pulp, and paper manufactured therefrom, or the quality of the paper may be varied by the admixture of a portion of rags or other filamentous substance.

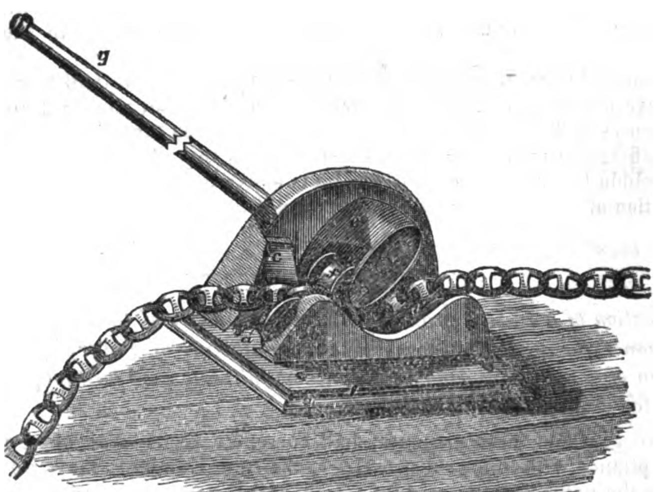
I would remark, that I am aware that some attempts have before been made to produce paper from the above mentioned material, but were abandoned from the incapability of producing good white paper.

What I claim is the mode or process herein described, for making white paper by the application of bleached pulp, produced from the stalks or leaves of Indian corn, which bleached material has not heretofore been so used.

Rep. Pat. Invent.

Baron De Bode's patent Cable Retarder and Stopper.

The cable stopper consists of an iron bed *a*, *a*, with upright side pieces, *b*, *c*, supporting two friction rollers, *d*, *d*; the side-piece, *c*, is higher and



stronger than *b*, and the short lever, *e*, carrying the friction roller, *f*, is connected to the handspike or lever *g*, by a strong axis or pivot, through the side piece, *c*. The action of the apparatus will be readily seen; the lever, *g*, being raised, the friction roller, *f*, will be above, and clear of the cable; as soon as it is desired to retard the chain, depress the lever, *g*, when the

cable will be clasped between the rollers, *f*, and *d*, *d*; and by further depressing the lever, *g*, so as to bring the roller, *f*, to a nearly central position, the chain will be stopped by being clutched between the roller, *f*, and a stud or elevation in the bottom of the stopper.

The following are among the advantages stated by the Baron to be consequent upon the use of his stopper:

Most of the stoppers have not the means of retarding the speed of a running cable which is known to be so pernicious to the men, and articles on deck, and those which can partially retard, can only do it at the destructive expense of both the cable and the stopper, as the cable has to rub through fixed bodies of metal; whereas, in the Baron's it slides between rollers.

The cable being stretched whilst running, when the speed is retarded by pressing the middle roller on it, there is no risk of destructive chafing, as it never gets in contact with the small elevation on the bottom of the stopper, until the middle roller is pressed down to the degree of stopping the cable altogether.

All stoppers hitherto in use stop the cable by pressing suddenly on one link only of the chain, whilst the roller of this one, presenting a larger surface, presses on three links; and instead of stopping the cable suddenly, can but stop it gradually, however quickly the operation may be performed. This must naturally prevent many ruptures, and even the frequent partial injuries to which cables are so subject.

This stopper will answer for a hemp cable as well as any chain of whatever size or figure it may be; whilst the other stoppers in use are still more destructive to hemp cables than to chains.

As the cable never has to force its way through two fixed metal bodies, there is no reason for either stopper or cables wearing out by the operation of stopping.

Most stoppers are by their angular opposition to the strain of the cable, and by their being fixed only to one of the ship's beams, more or less exposed to be broken or torn from their holdings, or even to injure the beam they are attached to, whilst this one, presenting a large basis may easily be fixed to three or more beams, by means of two cross beams underneath the deck; and as it works quite horizontally, it cannot be exposed to capsize, nor to be torn to pieces.

The construction being much simpler and more solid than all others, it is evident, that besides its not being so much exposed to the above aidents, it must in itself be less subject to repairs.

Lond. Mech. Magazine.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the Manufacture of Glass by the Egyptians.

The authority of Pliny* has been called forth to prove that glass was a late discovery of some Phœnician mariners, who having lighted a fire on the sea-shore, and supported their cooking utensils on blocks of nitre, were taught by the union of the fused substances the secret of this useful invention. The Roman naturalist had fixed no time for this event, and if he

* Plin. xxxvi, c. 26.

spoke of improvements in the art, introduced in the reign of Tiberius, it was presumed that, though a vitrified substance was known, its qualities were not properly understood, and that its discovery only dated about the Augustan age. They even objected, that, under the first Emperors, windows were made of a transparent stone, brought from Spain and other countries, called *Lapis specularis;* and they hence inferred the imperfect knowledge of glass.

This stone is now well known under the name of mica; it was only used in the houses of the rich, in litters, or as an ornament to the best apartments, other persons being content with linen, horn, or paper.

Such were the feeble arguments brought forward to disprove the use of glass, for vases and for ornamental purposes, among the Romans; but with much less reason did they apply to its invention in other countries; and though the Egyptians never knew the necessity, or rather the annoyance, of glass windows, under a burning sun, they were well acquainted with vases of that material; and the workmen of Thebes and Memphis, and subsequently of Alexandria, were famed for the excellent qualities of glass-ware they produced, with which Rome continued to be supplied, long after Egypt became a province of the Empire. Strabo was informed by a glassmaker of Alexandria, that a peculiar earth was found in Egypt, without which it was impossible to manufacture certain kinds of glass of a brilliant and valuable quality; and some vases presented by an Egyptian priest to the Emperor Hadrian, were considered so curious and valuable, that they were only used on grand occasions.

Such, too, was the skill of the Egyptians in the manufacture of glass, and in the mode of staining it of various hues, that they counterfeited with success the amethyst and other precious stones, and even arrived at an excellence in the art which their successors have been unable to attain, and which our European workmen, in spite of their improvements in other branches of this manufacture, are still unable to imitate; for not only do the colours of some Egyptian opaque glass offer the most various devices on the exterior, distributed with the regularity of a studied design, but the same hue and the same device pass in right lines directly through the substance; so that, in whatever part it is broken, or wherever a section may chance to be made of it, the same appearance, the same colours, and the same device, present themselves, without being found even to deviate from the direction of a straight line, from the external surface to the interior.

This quality of glass, of which I have seen several specimens, has been already noticed by the learned Winkelmann, who is decidedly of opinion that "the ancients carried the art of glass making to a higher degree of perfection than ourselves, though it may appear a paradox to those who have not seen their works in this material." He described two pieces of glass, found at Rome a few years before he wrote, which were of the quality above mentioned. "One of them," he says, "though not quite an inch in length, and a third of an inch in breadth, exhibits on a dark and variegated ground, a bird resembling a duck in very bright and varied colours, rather in the manner of a chinese painting than a copy of nature. The outlines are bold and decided, the colours beautiful and pure, and the effect very pleasing, in consequence of the artist having alternately introduced an opaque and a transparent glass. The most delicate pencil of a miniature painter could not have traced with greater sharpness the circle of the eyeball, or the plumage of the neck and wings, at which part this specimen has

been broken. But the most surprising thing is, that the reverse exhibits the same bird, in which it is impossible to discover any difference in the smallest details; whence it may be concluded that the figure of the bird continues through its entire thickness. This picture has a granular appearance on both sides, and seems to have been formed of single pieces, like mosaic work, united with so much skill, that the most powerful magnifying glass is unable to discover their junction.

"From the condition of this fragment, it was at first difficult to form any idea of the process employed in its manufacture; and we should have remained entirely ignorant of it, had not the fracture shewn that filaments of the same colours, as on the surface of the glass, and throughout its whole diameter, passed from one side to the other, whence it has been concluded that the picture was composed of different cylinders of coloured glass, which being subjected to a proper degree of heat, united by (partial) fusion. I cannot suppose they would have taken so much trouble, and have been contented to make a picture only the sixth of an inch thick, while, by employing longer filaments, they might have produced one many inches in thickness, without occupying any additional time in the process; it is therefore probable this was cut from a larger or a thicker piece, and the number of pictures taken from the same, depended on the length of the filaments, and the consequent thickness of the original mass.

"The other specimen, also broken, and about the size of the preceding one, is made in the same manner. It exhibits ornaments of a green, yellow, and white colour, on a blue ground, which consist in volutes, strings of beads, and flowers, ending in pyramidical points. All the details are perfectly distinct and unconfused, and yet so very minute, that the keenest eye is unable to follow the delicate lines in which the volutes terminate; the ornaments, however, are all continued without interruption, through the entire thickness of the piece.

Sometimes, when the specimens were very thin, they applied and cemented them to a small slab of stone of their own size, which served as a support on the back, and by this means they were enabled to cut them thinner, and consequently to increase their number.

Wilkinson on the Manners and Customs of the Ancient Egyptians.
Ed. N. Philos. Journ.

On the Composition of a new Indelible Ink. By Dr. Traill.

In a paper lately read before the Royal Society of Edinburgh, Dr. Traill, after an account of many unsuccessful experiments to produce a durable ink from metallic combinations, stated that he was induced to attempt the composition of a carbonaceous liquid which should possess the qualities of good writing-ink. The inks used by the ancients were carbonaceous, and have admirably resisted the effects of time; but the author found that the specimens of writing on the Herculaneum and Egyptian *papyri* were effaced by washing with water; and on forming inks after the descriptions of Vitruvius, Dioscorides, and Pliny, he found that they did not flow freely from the pen, and did not resist water,—qualities essential to a good writing-ink in modern practice. The carbonaceous inks with resinous vehicles, rendered fluid by essential oils, though they resisted water and chemical agents, had the disadvantages of not flowing freely from the pen, and of spreading on the paper, so as to produce unseemly lines. Solutions of caoutchouc in coal-naphtha, and in a fragrant essential oil, lately imported from South America,

under the name of *aceite de sassafras* (the natural produce of a supposed Laurus), were subject to the same objections. The author tried various animal and vegetable fluids as vehicles of the carbon, without obtaining the desired result, until he found, in A SOLUTION OF THE GLUTEN OF WHEAT IN PYROLIGNEOUS ACID, a fluid capable of readily uniting with carbon into an ink, possessing the qualities of a good, durable, writing ink. To prepare this ink, he directs gluten of wheat to be separated from the starch as completely as possible, by the usual process, and when recent to be dissolved in pyroligneous acid with the aid of heat. This forms a saponaceous fluid, which is to be tempered with water until the acid has the usual strength of vinegar. He grinds each ounce of this fluid with from eight to ten grains of the best lamp-black, and one and a half grain of indigo. The following are the qualities of this ink. 1. It is formed of cheap materials. 2. It is easily made, the colouring matter readily incorporating with the vehicle. 3. Its colour is good. 4. It flows freely from the pen. 5. It dries quickly. 6. When dry it is not removable by friction. 7. It is not affected by soaking in water. 8. Slips of paper written on by this ink have remained immersed in solutions of chemical agents, capable of immediately effacing or impairing common ink, for seventy-two hours, without change, unless the solutions be so concentrated as to injure the texture of the paper. The author offers this composition as a writing-ink, to be used on paper, for the drawing out of bills, deeds, wills, or wherever it is important to prevent the alteration of sums or signatures, as well as for handing down to posterity public records, in a less perishable material than common ink. He concluded his paper by stating, that should it be found to present an obstacle to the commission of crime—should it, even in a single instance, prevent the perpetration of an offence so injurious to society as the falsification of a public or a private document, the author will rejoice in the publication of his discovery, and consider that his labour has not been in vain.

Edin. New Phil. Journ.

ARTICLES FROM THE FRENCH JOURNALS. TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

Note relative to the Clarification of the water of the Nile,—and of water, in general, which holds earthy substances in suspension; by FELIX D'ARCET.

Travellers in Egypt have described, with more or less precision, the means generally employed to clarify the waters of the Nile, but they have not attempted to perfect this process, and have not pointed out the mode of operation. My sojourn in Egypt enabled me to study the process carefully, and the object of the following note is to furnish an account of it.

The waters of the Nile are turbid throughout the year, and during the inundation they contain eight grammes per litre, of earthy matters in suspension.

It is always clarified, but more for the purpose of avoiding the disagreeable taste of muddy water, than for objects of health; for many of the inhabitants of the villages of upper Egypt, drink the water as they draw it from the Nile, without being incommoded by it.

Two methods are practised in Egypt, for clearing the water of the

Nile from its slime. The first, employed only by the rich, because it is attended with considerable expense, consists in filtering the water, through porous vessels; the second, which may be practised by all, is effected by means of almonds.

The wealthy have in their houses large jars of porous clay, made at Kenne, a village of upper Egypt. They are placed on a wooden tripod in the most airy part of the house, and are kept constantly full of the water as drawn from the rivers, and the clarified water, which proceeds from them is received in tureens. By choosing the most airy place for the filtering jars, the temperature is somewhat reduced by evaporation, but the difference is scarcely sensible.

Many persons pay no attention to it, and the apparatus is often put into a portable closet to guard the filtered water from dust and insects which might spoil it. Each of the jars alluded to, costs at the factory, 1 franc 10 cent, but at Cairo they cost 3 francs 60 cent: they vary in capacity from 80 to 90 litres or quarts. They must be changed every year.

Every fifteen or twenty days the jars require to be cleaned from the impurities which collect upon them. It is evident that if the filtration was performed by ascension, they would remain clean much longer, but in a country where all the arts are in their infancy,* and where workmen could not be found capable of constructing or repairing the complicated apparatus used in France for clarifying water, for domestic purposes as well as for large manufactories, simple processes can alone be adopted.

The process of clarification first described, is altogether mechanical; —the other is due to a cause more complicated.

After having filled, with the troubled water, a jar much less permeable than those above mentioned, a loaf of almond flour, made for this purpose, is taken in one hand, and with the arm plunged in the water, the loaf is rubbed against the rough sides of the jar, until it is worn down to a mark previously made by the nail. The water is then stirred about effectually by the arm, then covered up and left at rest 4 or 5 hours, at the end of which time the water is clarified. It is the *Sacca*, or water bearer, who performs this office after bringing from the river the quantity necessary for the use of the house.

In rubbing the sides of the jar with the almond loaf, the *Saccas* hear a sharp hissing sound which they deem indispensable to the clarification. Another observation they make, better founded than the last, is that the water will not be clarified if it is agitated during the subsidence of the deposite or if the sediment be stirred up. This is analogous to what is observed in the clearing of wine, when entire repose does not succeed to the mixing of the troubled wine with the isinglass or albumine.

Almonds do not possess, alone, the property of clarifying;—for at Sennaar, at Dongolah, and in Nubia, beans are used and not unfrequently even the castor bean. Whatever the substance employed, the water, seldom acquires by this means, great limpidity, and how long soever the action may be continued, its limpidity remains with every pre-

*How curiously does this contrast with the expression, often used, that Egypt was the *cradle* of the *arts*, and with the undoubted fact that in this very country, almost all the utensils now known, were employed in the earliest recorded periods of civilization. How striking the revolutions which time produces in the condition of nations. Trans.

caution, more or less imperfect. The process of filtration, aside from considerations of economy, is therefore much to be preferred.

We find at Cairo and in all the bazaars of Egypt, the little almond loaves, I have been speaking of. They are made by pounding in a mortar, either sweet or bitter almonds, and afterwards working up the paste into the form and size of an egg.

These almond loaves are sold at 5 parats, or about 4 centimes each. They weigh at a medium 63.70 grains and may serve for a month. The jars used for this purpose are made in the neighbourhood of Cairo, of coarse clay and cost only 70 centimes.

In the last described process, the almonds in this state of minute division, produce a sort of emulsion, the oil unites to the earthy particles, and precipitates, thus facilitating their separation from the water. In this case the almonds act, if we may so speak, in an inverse manner to that of flax-seed cake in the clarification of oil. We know, that after having mixed sulphuric acid with oil to depurate it, a great quantity of parenchyma is carbonized by the action of the acid, and remains in suspension in the liquid, and that when the pulverised cake is stirred in and left at rest, the fecula of the cake, which contains water, unites with the carbonized parenchyma, separates it from the oil, carries it to the bottom and thus perfects the clarification of the liquid. Might we not conclude, incidentally, that flax-seed cake would serve to clarify turbid water?

Perceiving the imperfection of the process adopted in Egypt, for clearing the waters of the Nile, by means of almonds, I attempted to employ alum which has long been indicated, and which my father had successfully used in clarifying the water of the Seine. My results were very satisfactory.

With half a gramme (about 8 grs. troy) of alum to a quart of water, I produced in an hour's time, complete clarification, and the water became extremely limpid. Half the quantity of alum produced the same effect but it required a little more time. The alum produces no unpleasant effect upon the health, for 4 grains or even 8 grains, to a quart are quantities so small that this effect is a perfect nullity. Besides, in this mode of clarification, the alum acts only by undergoing decomposition; the excess of acid it contains is saturated by the carbonate or bicarbonate of lime in the water, and it is only in passing to the state of an insoluble subsulphate, which is precipitated, carrying with it mechanically the earthy particles, that it produces the desired limpidity in the water.

It is preferable, in this process, to employ the alum in large pieces. The best way is to fasten a large crystal of alum to the end of a thread and move it in all directions through the water just below the surface, and taking it out as soon as large flocculi appear. The formation of a sediment is a certain sign that the requisite dose of alum has been dissolved.

If it be desired to use powdered alum, in order to be more certain of the right quantity, it must be reduced to a fine powder, weighed, and then sprinkled on the surface of the water, avoiding any considerable agitation after the salt has been added.

We may also dissolve, in a small quantity of clear water, the quantity of alum we wish to employ, and to pour this solution on the turbid

water, stirring the surface slightly after the addition, and letting it rest. It becomes speedily clarified, and very limpid.

The sediment which alum gives, increases in weight much beyond the limits which the salt would proportionately afford. The quantity before mentioned might therefore be increased without inconvenience. The experiments made in Egypt, were with alum with a base of potash but I think that alum with a base of ammonia would yield similar results.

I recommended, as far as practicable, this mode of clarification, which always succeeded perfectly, during my stay at Cairo, and I hope that in a few years it will be generally followed. They had begun to prepare at the time of my departure, little packets of alum for this purpose.*

Ann. des Ponts et Chaussees.

Note on the Steam Engine of Savery, by COLLADEN *and* CHAMPIONNIERE.

We are in possession of but a small number of exact data relative to the effect of machines, and especially on *motive powers.* Chosen some years ago to give a course on mechanics, at the Central School of Arts and Manufactures, I was obliged often to have recourse to experiments, to ascertain the useful effects of *steam movers*, (moteurs à feu.) The note which I present to the Academy, is a summary of the expeiments I made with M. Championniere, civil engineer, with the steam engine on *Savery's construction.*

In these very simple machines, the steam raises the water by its immediate action. The steam is introduced into a vessel, then condensed, and produces a respiration or flowing in of water.

A second admission of the steam drives the water up into the reservoir.

These machines were the first steam movers employed in large works. They were afterwards abandoned for the machines of Newcomen and Watt.

Several manufacturers, especially Manoury D'Hectol, nevertheless have employed them.

As our experiments may serve to fix the value of these engines, and the conditions under which the employment of them may be preferable, we think it may be useful to publish them.

We possess very few estimates of the power of the Savery machine:—Bradley, Smeaton, Manoury and Girard, have published some memoirs on its effects; but we find in no publication on the subject, the measure of increase of heat in the water elevated, nor of any other element needful to the theory of these motive powers.

But a very small number of the Savery machines are in existence. We know of but *five in operation, three are in the department of the Seine, the fourth in Loire Inferieure, and a fifth at Lyons.* We believe there are none remaining in England.

We have experimented with the three of the department of the Seine. The oldest is at the *abattoir de Grenelle*, and was constructed by Manoury. The two others are in the Vigier baths; they were made by Gingembre.

* Compare this recommendation of alum with the objections made to its use in the paper of Arago on filtration, published in the last number of this Journal.

The following numbers were obtained from these three machines in three series of experiments.

Experiment of the 26th March 1833, on the bath machine of Pont Marie.

Temperature of the water of the Seine,	$6\frac{1}{4}°$
Mean tension of the steam,	3atm.
Water raised per hour,	12.213m.
Height of elevation,	6.6m.
Temperature of the water raised,	$10\frac{1}{4}°$
Dry wood burned during one hour,	30.4k.
Duration of a period,	26.0″

Experiment of the 10th July 1833, with the same machine.

Temperature of the water of the Seine,	$19\frac{1}{4}°$
Mean tension of the vapour,	3atm.
Water raised per hour,	12.724m.
Height of elevation,	6.10m.
Temperature of the water raised,	$23\frac{1}{2}°$
Dry wood burned in an hour,	46kil.
Duration of a period,	26″

Experiment with the machine of Manoury D'Hectol.

Temperature of the water of the well,	$12\frac{1}{2}°$
Mean tension of the steam,	00
Water raised per hour,	15.400m.
Height of elevation,	14m.
Temperature of water raised,	$16\frac{1}{2}°$
Charcoal burned in an hour,	13kil.
Duration of a period,	90″

Agreeably to the first and second tables, the machine of Pont Marie gives 2.595 dynam, to a kilogramme of wood.

This is about eight times less than the effective force of a small piston machine of the same force which would work pumps. But the water raised would have to be afterwards heated, so that we must take into account the increase of temperature, which was four degrees Cent. (= $7\frac{1}{5}$ F.) in the first series, in the month of March, and three quarters in the second in July. Thus, in the first case, each kilogramme of wood sent up to the reservoir, by the action of the machine 1702, portions of heat (caloric) and in the second 1255. With a more complicated machine than that of Savery, an additional heating apparatus would have been necessary, and this addition would have required the same expense.

Thus, whenever water is to be both raised and heated (and this often occurs in manufactories) the almost forgotten machine of Savery is the most advantageous motive power. It is the least costly at first, the least subject to accidents, and to wear and tear, and the most easily managed.

We will add a few words on the comparative effect of the three machines. In all of them the accession of heat was about four degrees, although the Manoury machine differs essentially from the two others.

The last machine performs more than double the work of those of Gingembre, at the same cost. Agreeably to the public report of M. Girard, in the 21st Vol. of *Annales de Physique et de Chimie*, the Manoury

machine gave 20.202 dynam for each kilogramme of charcoal. This result surpasses that obtained by us, whence the increase of temperature of the water must at that time have been at a maximum of 2.8° instead of 4°. This measure is wanting in the memoir referred to.

From the foregoing experiments it results:

1. That the Savery machine is a very valuable motive power which may be advantageously employed in many of the arts.

2. That the use of it ought to be limited to those cases in which water is to be heated as well as elevated.

3. That the machine of Manoury is the best model for imitation.

Ann. des Pontes et Chaussees.

Blasting of Rocks.

Means of kindling a blast, without danger, at the bottom of a well or shaft, without risk of failure.

Very brief notices may sometimes render great service, and when they have the stamp of utility upon them the Ann. des Ponts et Chaussées, will register them with pleasure.

The following will strike every reader by its simplicity; but it may, nevertheless, prevent some fatal imprudencies and save the lives of miners.

We allude to the difficulty of blasting a rock at the botton of a well, or other excavation, where there is no place for the miner to retreat to for safety.

When the priming is furnished with a piece of touch-wood, it is often fired by throwing down burning paper or other ignited bodies; but when the explosion does not take place, after a considerable time has elapsed, it has happened that on going to examine the charge, it has exploded, and death or dreadful wounds have been the consequence. The means, therefore, of safely igniting the match must be a matter of interest. For this purpose M. Devilliers' proposes the following simple method.

The miner, before ascending, fastens a wire to the touch-wood which communicates with the priming, and extends this wire, as he ascends, to the surface; being careful to prevent any knots from remaining in it.

A bunch of touch-wood, pierced with a hole through its centre, is fired and allowed to slide down the wire, giving the operator full time to retreat to a place of safety, while the kindling of the match at the bottom can hardly fail to take effect.

Ibid.

In all ordinary cases, the safety fuse described at page 63 of our last volume, might be deemed preferable to the mode above suggested. We know not whether it (the safety fuse) has been introduced, and used in the United States, or not;—but in point of cheapness the wire guide now proposed, might be preferable, and perhaps it would be as certain in its effect. G.

Report to the Societé d'encouragement, on two prizes,—one for perfecting the fabrication of dextrine, and its application to the useful arts;—the other for the extraction of sugar from dextrine; by M. Payen.

The numerous and useful applications of dextrine obtained by the various means by which starch is disintegrated, make it extremely desirable that this new commercial product should be obtained as free as possible from colouring matter, and of a uniform quality, so that it may, with all its advantages, be used as a substitute for the gums in the preparations of various tissues, both white and of transparent shades,—for coatings and colourings of paper hangings,—for giving a lustre to prints and coloured lithographs,—for extending sheets in drawings,—and other applications pointed out by the Baron de Silvestre.

The society will adjudge a premium of 2000 francs, to the best solution of this question, provided, the author shall manufacture it in such a quantity as to throw into the market at least 600 kilogrammes, per day, of a good and even quality.

The competitors must furnish a complete account of the various uses of dextrine* and indicate the factories or places where the committee may witness its successful applications.

Various laboratory trials and applications in the large ways, have demonstrated that it is possible to convert, by means of diastase, starch into sugar, whiter, purer, and of a better taste than that which is produced by the saccharification of starch by sulphuric acid. The latter indeed, has a styptic taste, and a disagreeable odour, and contains besides, a notable portion of calcareous salt which is injurious in some of its applications. There are other inducements for avoiding the use of a powerful acid in manufactures destined to spread through the country.

The sirops and sugars of dextrine, obtained from germinated grain, are commonly exempt from these defects; but their preparation demands more skill, especially in developing, by means of germination, the greatest quantity of the active principle, and avoiding any injurious change in it. There is some difficulty also, to be overcome, in thoroughly clarifying and filtering sirops, and in evaporating them so as to avoid the production of colour.

The Societè d'encouragement, desirous of rendering the conversion of starch into sugar, an easily attainable object without the intervention of sulphuric acid, offers a premium of 3000 francs, to any one who shall completely succeed in this enterprise, and establish a safe and easy process which may be followed without risk of failure.

The sugar thus prepared must be white, solid or grained, of a free, sweet taste, immediately applicable to the making or improvement of the different kinds of beer, cider and wine,—to confectionaries, preserving fruits, and grapes, to eduleorating drinks, and be decidedly preferable in this respect to solutions of liquorice.

*Starch, in its several varieties, consists, (when examined by the microscope,) of small brilliant spherules, each of which has a coating less soluble than its interior. Heat bursts these envelopes and lets out their contents, which consist of a gum-like substance, to which the name of *Dextrine* was given by Biot. It is much the same as the *Amidine* of Saussure, and of the chemical books. Trans.

It is not required that this product should be a substitute for cane or beet sugar, as the peculiar nature of grape or starch sugar would hardly admit of it.

A manufactory of 300 kilogrammes a day, must be in operation so that the society may witness the process and prove the good quality of the article produced.

The Society holds itself ready to offer premium medals to any one who makes the nearest approach to the object in view, either in preparing sugar or sirop—or in their application.

Bull. d'encour, Decem.

Compensation Pendulums; by M. Wiesniewsky.

It is well known that the system of compensation by mercury, contrived by Graham, consists of a glass vessel filled with mercury, which fastened to a strong rod, performs at once the office of a bob or lens, and of a compensator. But this compensation is very imperfect, inasmuch as it is not affected by the sudden changes which take place in the ambiant atmosphere, and which are often very considerable. To perfect it, M. Wiesniewsky proposes to render the temperature uniform, throughout the pendulum, by distributing the mercury through a number of small hollow iron cylinders, disposed symmetrically on each side of the rod. By greatly increasing the surface of the mercury in proportion to its volume a much more rapid change of temperature will take place in the metal, the rate of which will be expressed by a formula based on experiment, made for the purpose. The equation of the curve of the generating surface of the exterior surface of the iron rod, may then be obtained, a curve which will satisfy the conditions of the problem, viz: that the progress of temperature throughout the whole length of the rod may be always conformable to that which takes place in the mercury. Ibid.

New process for cleaning cloth from grease; by M. Martin.

This process, which is very easy, consists in washing the cloth in warm water to deprive it of paste or gum, then to impregnate it with a mixture of Fuller's earth, potash or other alkaline material, and, thus prepared, to suspend it in a tight box or receiver and subject it to the action of a jet of steam. When withdrawn, it is thrown into the water and passed between two cylinders to clean it.

The cloth, in this process, receives no fulling, and by means of a small boiler, which costs but little, a large amount of work can be rapidly performed. Ibid.

Progress of Physical Science.

Simultaneous Meteorology.—No. V.

TABLE OF HOURLY METEOROLOGICAL OBSERVATIONS, made during the 21st and 22nd Dec., 1837, at BLACKHEATH ROAD, near Greenwich, about four miles and a half S. E. of London, *by and under the superintendence* of J. H. BELVILLE, in conformity with the Instructions circulated by the South African Literary and Philosophical Institution.

DATE.	HOUR.	Barometer.	THRM. Attach'd	THRM. In open air.	WIND. Direction.	WIND. Str'gth.	Prop. of Cloud.	STATE OF THE ATMOSPHERE, CLOUDS, &c.
		Eng. In.	F. °	Fah. °				
Thursday, December 21, 1837.	VI. A.M.	29.760	53	42.4	N.	3	10	Stormy high wind; densely cloudy.
	VII.	29.840	53	42.0	N.	3	10	Ditto. ditto.
	VIII.	29.895	53	42.0	N.	2	10	Clouds broken; more moderate.
	IX.	29.958	52	41.1	N.	2	7	Getting clearer. *Sunshine at intervals.*
	X.	30.020	52	41.2	E.b E.	2	5	Passing drops of rain since last obs.
	XI.	30.080	52	41.2	N.N.E.	2	6	Much driving cloud *scud* from N.N.E.
	XII.	30.110	51½	41.2	N.N.E.	1	6	Wind going down. Air getting dry.
	I. P.M.	30.120	52	42.5	N.N.E.	1	5	Little or no variation.
	II.	30.136	51	41.5	N.NE.	1	10	The same.
	III.	30.153	51	41.4	N.N.E.	1	10	Getting now more overcast, and no wind.
	IV.	30.200	51	41.0	N.E.	1	10	The maximum by a self-registering thermometer 43°.1.
	V.	30.225	50	40.5	N.E.	1	10	
	VI.	30.294	51	40.8	N.ly.	1	10	N. B. Barometer very unsteady for two or three hours.
	VII.	30.250	52	40.2	E. b S.	1	10	
	VIII.	30.239	51½	39.4	E.S.E.	0	10	
	IX.	30.251	51	40.1	S.	0	10	A completely covered sky, and no variation in its appearance for these 15 hours.
	X.	30.292	51	39.2	S.	0	10	
	XI.	30.268	51	39.1	S.	0	10	
	XII.	30.254	51	39.0	S.	0	10	
Friday, December 22.	I. A.M.	30.250	51	39.0	S.	0	10	
	II.	30.241	51	39.0	S.S.W.	1	10	
	III.	30.208	51	39.1	S.S W.	1	10	
	IV.	30.182	51	39.5	S.S.W.	1	10	The min. by a self-registering therm. 38°.2.
	V.	30.157	51	40.0	S.W.	1	10	
	VI.	30.150	51	40.6	S.W.	1	10	
	VII.	30.132	51	41.0	S.W.	2	10	Clouds a little broken. The lowest of a radiator on the ground, 37°.
	VIII.	30.114	51	42.6	S.W.	2	10	Quite thick.
	IX.	30.100	51	42.9	S.W.	2	10	The same.
	X.	30.090	49	44.1	S.W.	2	10	The same; *scud* swiftly moving from S.W.
	XI.	30.080	50	45.5	S.W.	2	10	The same.
	XII.	30.062	50	46.0	S.W.	2	10	The same; drizzling rain.
	I. P.M.	30.030	51	47.0	S.W.	2	10	The same.
	II.	30.011	51	48.0	S.W.	2	10	The same.
	III.	30.000	51	48.0	S.W.	2	10	The same; sky gets turbid and gloomy.
	IV.	29.981	51½	48.0	S.W.	2	10	The same.
	V.	29.974	52	49.1	S.W.	2	10	The same.
	VI.	29.958	52	49.5	S.W.	2	10	The same.

NOTES.—A violent gale night of the 20th and morning of the 21st, from W N.W. and N. At 1 A. M, the barometer at 29.32, and as the wind got to the N.W. and

Extract of a letter from Sir John Herschel, to the President of the Royal Astronomical Society, giving an account of a remarkable increase of magnitude of the star η in the constellation ARGO, *observed by him at the Cape, December* 16*th*, 17*th*, 1837.

"I have just observed a very remarkable phenomenon, the development of which I am watching with much interest. It respects the nebulous star η in the constellation *Argo*, No. 1281 of the Catalogue of the Astronomical Society, marked in that catalogue as of the second magnitude. As such, or rather as intermediate between the first and second, as a very large star of the second magnitude, or a very small one of the first, I have always hitherto observed it, having in some cases equalized it with *Fomalhaut*; in others placed it intermediate between α and β *Crucis*, nearly equal with the latter, &c.; nor have I at any time had reason to suppose its magnitude variable. To night, however, being at work on my classification of the southern stars in the order of their magnitudes, I was much astonished to find its magnitude superior, not only to that of *Fomalhaut* and α *Crucis* (with which stars it no longer admits of a moment's comparison,) but even to that of *Aldebaran*, *Procyon*, α *Eridani*, α *Orionis*, and little if at all inferior to that of *Rigel*.

"This was my own judgment, and that of several persons whom I called to my assistance, in the early part of the night, when η was low and *Rigel* high in the heavens. At the time I write, they have about equal altitudes, and the comparison is decidedly in favour of η, which is in fact (*Sirius* and *Canopus* excepted,) the most brilliant star now visible; α *Centauri* being too low for fair comparison, and veiled with some degree of haze.

"This remarkable increase of magnitude has come on very suddenly, as my attention has frequently of late been drawn to this star in the lower part of its diurnal circle, while watching with some impatience its progress towards the meridian, at a reasonable hour of the night, that I might resume and complete, before my departure hence, a very elaborate monograph of the wonderful nebula which surrounds it. A few evenings before the full moon just passed, in particular, I remember to

N., it rose at the rate of above 1-10th of an inch in an hour; the thermometer, at noon on the 20th, rose to 55°, a degree of warmth very uncommon on the day preceding the winter solstice.

A remarkably cloudy period; not a star visible during the whole night. The atmosphere was covered with one mass of dense cloud; the sun, likewise, was not once seen on the 22nd.

The time was taken from a good clock, keeping mean time. Rate scarcely perceptible. Error obtained by observation of the ball-drop of the Royal Observatory, Greenwich.

The Barometer has an elevation of 46 feet above *mean high water mark* of the river Thames, carefully deduced by very accurate barometrical measurement. The index error of scale presumed to be within a *hundreth* or two of the truth. The Thermometer, by Dollond, suspended in open air, at an elevation of 40 feet from the ground: aspect, northerly.

The comparative strength of wind is indicated by the figures thus,—0 means no wind perceptible; 1, very light breeze; 2, strong; 3, a gale. In the column headed *Proportion of cloud*, 0, signifies quite clear; 10 no blue sky visible; 5 sky half covered.

have noticed it with this view; and had it then been what it now is, a star of the first class, it could not have passed unremarked.

"Whether it be now at its maximum, and about to decrease by insensible degrees; whether, like *Algol*, but in a much longer time, it remains as it were dormant through the greater part of its period, and runs through its phases of increase and decrease in a small aliquot portion of the whole; or whether, lastly, it be on the point of blazing forth with extraordinary splendour, so as possibly to outshine its brilliant neighbours, *Centauri* and *Canopus*, it is useless to conjecture, and observation will soon determine."

The President read an extract of a letter from Mr. Henderson relative to the remarkable increase of magnitude, in *η Argus*, recently noticed by Sir John Herschel, as mentioned at the last meeting of the Society. Mr. Henderson states that the star is not to be found at all in Ptolemy's catalogue, although the bright stars of the Cross and the Centaur, which culminated as low at Alexandria, are inserted in it. From this circumstance he infers that, at this remote period, the star was not very bright. It is not in Bayer's maps; and in Halley's catalogue it is said to be of the *fourth* magnitude, which is less than some of the neighbouring stars that in modern times cannot compete with it. It would thus appear that the star has for a long period been increasing in brightness; and it will be remarkable if it should surpass the brightest at present known.

Lond. and Edin. Philos. Mag.

Proceedings of the American Philosophical Society.

February 16, 1838—Dr. Patterson, V. P. in the Chair.

Electricity.—Professor Henry, of Princeton, made a verbal communication on the lateral discharge of Electricity while passing along a wire, as in the Leyden experiment, or communicated directly to an isulated wire, or to a wire connected with the earth; and detailed various experiments, proving that free electricity is not, under any circumstances, conducted silently to the earth.

March 2.—Mr. Du Ponceau, President, in the Chair.

Longitude.—Mr. Walker read a paper, entitled "Determination of the Longitude of several Stations near the Southern Boundary of Michigan; calculated from Transits of the Moon and of moon culminating Stars, observed in 1835 by Andrew Talcott, late Captain of United States Engineers."

The longitude of places in the United States, north of the Ohio, had hitherto depended on the observations of Ellicott and De Ferrer, made at points on the banks of the Ohio river, and on meridian lines drawn from this river, several hundred miles northward, by the deputy surveyors. From Mr. Walker's computations, it appears that *Turtle Island, Lake Erie*, has been placed only 1.7 geographical miles too far east on Tanner's Map. Its true place is 41° 45′ 9″ N. latitude; and 5 hours, 33 min. 34.3 sec: W. longitude from Greenwich. Also, *South Bend Lake, Michigan*, has been placed 3.9 miles too far east; its true place being N. 41° 37′ 6″; W. 5 hours, 49 min. 15.3 sec. These observations of Capt. Talcott will prove highly useful to geographers, by furnishing standard points of reference in the northernmost parts of the United States.

May 4.—Dr. Patterson, V. P., in the Chair.

Electricity.—Dr. Patterson read a letter from Professor Henry, of Princeton, dated May 4, 1838, announcing that, in recent experiments, he has produced directly from ordinary electricity, currents by induction analogous to those obtained from galvanism; and that he has ascertained that these currents possess some peculiar properties, that they may be increased in intensity to an indefinite degree, so that if a discharge from a Leyden jar be sent through a good conductor, a shock may be obtained from a contiguous but perfectly insulated conductor, more intense than one directly from the jar. Professor Henry remarks that he has also found that all conducting substances screen the inductive action, and that he has succeeded in referring this screening process to currents induced for a moment in the interposed body.

Fused Platinum.—Dr. Hare exhibited to the Society fourteen and a half ounces of platinum, fused by his hydro-oxygen blowpipe, and a specimen of pure platinum, freed from iridium by the process of Berzelius.

Steam Navigation.—Dr. Patterson submitted to the Society's inspection the log-book of the steam-ship Savannah, Capt. Moses Rogers, launched at New York on the 22d August, 1818; from which it appears that, after repeated voyages between New York, Savannah, and Charleston, this vessel left Savannah on the 24th or 25th of May, 1819, for Liverpool, saw Land's End on the 17th of June, and arrived at Liverpool, on the 20th of June, having used steam thirteen days, and having exhausted her fuel (coal) three days before arrival. It also appears from the log-book that she left Liverpool on the 23d of July, arrived at Elsineur on the 9th of August, left Elsineur on the 14th of August, arrived at Stockholm on the 22d of August, left Stockholm on the 5th of September, arrived at Cronstadt on the 9th of September, and after several excursions between Cronstadt, &c., and Copenhagen, &c., left Arundel, Copenhagen, on the 23d of October, and arrived at Savannah on the 30th of November; that she subsequently arrived at Washington from Savannah on the 16th of December, after a passage of eleven days; that she was sold at Washington in September, 1820, and her engine taken out, after which she sailed as a packet, from New York to Savannah, until September, 1822, when she was lost. This log-book was supposed to derive additional interest from the recent arrival of the Sirius and Great Western, steam-ships, at New York, from England.

Solidifying Carbonic Acid.—Dr. Mitchell repeated before the Society Thilorier's process for solidifying carbonic acid, with an apparatus, made under his direction in Philadelphia, somewhat modified from that employed by Thilorier, and froze a quarter of a pound of mercury by the admixture of the solidified acid with nitrous ether.

May 18.—Mr. Du Ponceau, President, in the Chair.

Elements of Water.—Dr. Hare communicated orally, that he has found that when the elements of water are exploded in contact with certain gases or essential oils, the aqueous elements, instead of condensing, combine with the hydrogen and carbon, and form a permanent gas.

July 20.—Mr. Du Ponceau, President, in the Chair.

Magnetic Dip in Ohio.—The Committee, appointed on the Communication of Dr. John Locke, of Cincinnati, read at the last meeting, made the following Report, which was adopted.

"The Committee to whom was referred the Communication of Professor John Locke, of Cincinnati, report that it gives the details of a series of experiments, made for the purpose of determining the magnetic intensity and dip for certain positions in Ohio. For these experiments he had furnished himself, in London, with the best apparatus, and had vibrated there two needles of the form recommended by Hansteen, and one in the form of a small flat bar. Five months afterwards, namely on the 17th of January, 1838, he again vibrated these needles at Cincinnati, and found the ratio of horizontal intensity at the former place to that at the latter, as follows: by needle No. 1, as 1 to 1.1624; by needle No. 2, as 1 to 1.1639; by No. 3, as 1 to 1.2037. Of these results, the author prefers the last; inasmuch as the magnetism of needles is liable to decrease, but not to increase.

"On the 20th of August, 1837, he made experiments with his dipping needle, to determine the dip at Westbourn Green, near London, the mean of which gives 69° 23'.3.

"On the 26th of Nov. 1837, the mean of a series of experiments made at Cincinnati, in lat. 39° 6' N., and long. 84° 27' W., gave the dip = 70° 45'.75.

"At Dayton, Ohio, in lat. 39° 44' N., and long. 84° 11' W., the dip was found to be 71° 22'.75 on the 26th of March, 1838.

"At Springfield, Ohio, in lat. 39° 53' N., and long. 83° 46' W., the dip was found, on the 29th of March, 1838, to be 71° 27'375.

"At Urbana, lat. 40° 03' N., long. 83° 44' W. March 30, 1838, the dip was found = 71° 29.'94.

"At Columbus, the seat of government of Ohio, lat. 39° 57' N., long. 83° W., April 3d, 1838, the dip was found = 71° 04'.875.

"The interest of this paper is much increased by the circumstance that no accurate experiments on the intensity and dip of the needle have heretofore been made in the United States, west of the Alleghany mountains."

Dipping Needle for finding Longitude.—Dr. Patterson laid before the Society, copies of a Memorial presented to Congress by Dr. Henry Hall Sherwood, and of a Report thereon by the Committee on Naval Affairs of the Senate, in which are set forth Dr. Sherwood's "claims to have made new and important discoveries in magnetism generally, and more particularly in the magnetism of the earth; and to be the inventor of an instrument called the geometer, whereby, without the aid of the quadrant or sextant, or chronometer, and without taking a celestial observation, it is practicable and easy, at sea and on land, and in all weathers, to determine, merely by the dip of the needle, the variation of the needle, and the latitude and longitude of any place on the surface of the globe."

Dr. Patterson called the attention of the Society to some further extracts from the Report of the Naval Committee, in which it is stated that from the opinions obtained from scientific men, "as well as from their own examination, they are fully persuaded that the discoveries and invention of Dr. Sherwood are entitled to the most serious consideration of the public, and to the encouragement and patronage of Congress;" that they "regard them as highly interesting and important to the navigation and commerce of the United States, and as bidding fair to open a new era in the history of the science of magnetism." Of this Report 5000 additional copies were ordered to be printed by Congress.

Dr. Patterson remarked that the imposing circumstances under which

Dr. Sherwood's extraordinary claims were brought forward, might make a brief review of them worthy of the Society's attention.

1. The first of Dr. Sherwood's asserted discoveries is the communication of magnetism to a steel plate or ring, which he supposes others had failed to do. Dr. Patterson observed that, on the contrary, nothing is better known in experimental science than that magnetic polarity can be given to steel in any form, and with as many poles as the operator pleases. In illustration of this remark, he exhibited to the Society a steel plate, prepared some years ago by Mr. Saxton, who was then in London, according to an experiment first made by Chladni, on which polar lines were traced, so as to mark on one side the word '*magnet*,' and on the other the date '*24th of February*, 1836;' the position of the lines being made apparent by strewing steel filings over the plate.

2. Dr. Sherwood asserts that, if a steel ring, marked in two opposite points, have magnetism communicated to it by passing it over a magnet from one of those points to the other, in a way which he describes, the magnetic poles will be found to reside, not in the marked points which he styles the poles of the ring, but in other points distant from them 23° 28′, thus exhibiting a correspondence with the obliquity of the ecliptic. On this fact he founds his theory of the magnetism of the earth. Dr. Patterson mentioned that Mr. Saxton and himself had carefully repeated this experiment, and had found, without surprise, that the assertion of Dr. Sherwood was entirely erroneous. When the magnetism was communicated in the awkward manner used by Dr. Sherwood, the poles were not indeed at the points of the first and last contact of the magnet; but the deviation was irregular, was different at the different poles, and bore no relation to the obliquity of the ecliptic. When the magnetism was communicated to the ring by carefully setting two opposite points on the poles of a horse-shoe magnet, the *magnetic* poles of the ring coincided exactly with those points. This fact was shown in an experiment made before the society.

3. As to the hypothetical deductions of Dr. Sherwood, "that the magnetic poles of the earth are 23° 28′ from its poles, and of course within the polar circles," "that the magnetic and polar axes cross each other at the same angle of 23° 28′," "that the magnetic and terrestrial meridians of every place cross each other at angles dependent on the angles of the two axes," and "that the line of no variation is a great circle of the earth, and is that magnetic meridian, which, after cutting the magnetic pole, passes at the distance of 6° 28′ from the pole of the earth,"—Dr. Patterson remarked that these notions were directly contradicted by well-observed facts, that there are more than two magnetic poles, that the magnetic poles are not in the polar circles, that there are several lines of no variation, and that those lines are not great circles, but are altogether irregular in their course.

4. The practical applications of Dr. Sherwood's theory are announced in these terms: "With the correct dip given him, observed at a given time, he works out all or either of the following results: the variation of the needle, the distance of the circle of no variation from the place, and its angle with the meridian, and the latitude and the longitude. With the variation given him, in the same manner, he determines the dip and the other results. He must know, however, if the dip be given, whether the place of observation is east or west of the circle of no variation, and if the variation be given, whether it is north or south of the magnetic equator, and near the arctic or antartic semi-circle of no variation."

It is sufficient to remark, said Dr. Patterson, on this train of assertions, that they necessarily assume the truth, within the limits which are stated, of two positions: 1st. that the same dip will always correspond with the same variation, and 2d, that every place on the earth's surface has a different dip from all others,—both of which are notoriously untrue. The various examples, contained in the Report, of calculations made from the single datum of the dip or the variation, and which give for results all the other particulars with an accuracy extending not to seconds merely, but to thirds, must be regarded as illusory.

Mr. Walker also made a verbal communication on the subject of Dr. Sherwood's alleged discoveries. He remarked that even admitting the correctness of the Doctor's hypothesis, as stated in his Memorial to Congress, still his method would be of no use for nautical or geographical purposes, for the following reasons:—

1. The apparatus for determining the dip and variation of the compass is more costly than a common sextant and mercurial horizon.

2. The observations of the dip and variation of the compass are more difficult to be made with accuracy than a common lunar observation.

3. The reduction of these magnetic observations, on the Doctor's hypothesis, would be more laborious than the working of a lunar observation.

4. Mr. Walker proceeded to show, in conformity with the remarks of Dr. Patterson, that Dr. Sherwood's assertion that he can determine the latitude and longitude from the dip alone, or from the variation alone, was contrary to the first principles of the geometry of position; since a point, in order to be determined in space, must be referred to three given surfaces. If one of them is the surface of a spheriod as in geography, then the point must be referred to two other given surfaces; whereas by the dip alone, or the variation of the compass alone, a point can only be referred to one of these two surfaces, and the resulting locus is a line and not a point. Hence, if latitude and longitude are determined by magnetic observations, it must be by both the dip and variation. Dr. Sherwood's method, therefore, could be of no use for *nautical purposes*, from the impossibility of observing the variation of the compass at sea with any tolerable degree of accuracy.

5. Dr. Sherwood's assertion that the magnetic method could be used in cloudy weather is inaccurate; since the variation of the compass cannot be ascertained without astronomical observations.

6. Restricting then the use of magnetic observations to those made on land in fair weather, still, owing to local perturbations, the probable discrepancy of the mean of many observations at one place from the theoretic dip and variation, may, at a low estimate, be assumed to be ten minutes of space, and, as the resulting errors of *latitude* are of the same order, we shall have ten miles for its probable error, which is *twenty times* that of a common sextant and mercurial horizon.

7. Owing to the proximity of the north pole to Dr. Sherwood's assumed magnetic pole, the probable error in the resulting *longitude* would far exceed that of the dip and variation themselves, and would amount to *forty* miles on the average, and between the tropics, near the line of greatest variation, to *several degrees*; whereas it is well known that by the lunar method, the probable error in longitude is less than *six* miles, and may be reduced to *four* by means of half a dozen observed eclipses of Jupiter's first satellite.

Mr. Walker concluded by remarking that although, in stating the practical objections to the method, he had taken Dr. Sherwood's postulates for granted, yet he considered every one of them as contrary to facts, observation and experience.

Progress of Civil Engineering.

Early Progress of Railways.

The following historical sketch of the progress of the railway principle, is extracted from the last number of *Fraser's Magazine*:—

"Among the proofs constantly brought forward by those who assert that the ancients were merely children in science, we have frequently seen allusion made to railroads. And yet this vaunted discovery of the younger children of Time seems to have been known to their elder brothers. At least we find Æschylus speaking, in the *Eumenides*, of a road from Athens to Delphi; which, to use his own words, Κελευθοποιοι παιδες Ηφαιστου, 'the road-making sons of Vulcan,' (the god of blacksmiths) constructed, χθονα Ανημερον τιθεντες ημερωμενην, 'converting a country previously wild into a civilised one,' and thus producing the very results to which Lord Brougham and his school are constantly pointing, as the beneficial consequences of the rail-road system. To what extent this principle was carried in other parts of Greece, we know not; but in a mountainous country, where there was no lack of ironstone, nor of the means of converting the ore into bars of iron, it is probable that other roads were constructed of a similar kind. Yet so little notice has been taken of them, that, but for the accidental preservation of the *Eumenides*, we should have been unable to understand the language of Herodotus. That historian, speaking of the sacred road from the sea-coast to Heliopolis in Egypt, says that it was 1515 stadia long, and exceeded by 15 stadia the one which led from the temple of the twelve gods in the forum at Athens to the temple of Jupiter, on Mount Olympus. But, whatever may have been the knowledge of the ancients respecting the principle of an iron railroad, it does not appear that they applied it to the increase of the wealth of a nation—the only thing valuable in the eyes of a Baconian worshipper of Mammon. They were content, it seems, to devote their energies to making an easier road to the temples of their faith; we, to the marts of commerce: and unless London, Birmingham, Manchester, and Liverpool, be brought within a ride of twenty-four hours, the political economists tell us that the work of the Creator has been only the job of a bungler, and that till we can fly along a railroad with the velocity of a pigeon through the air, we must be, and deserve to be, hooted at by other nations, as the silliest of bipeds without feathers.

"With regard to the principle by which heavy bodies are rolled along a smooth and level road, it appears to have been put in practice at the siege of Constantinople, when Mahomet conveyed eighty light galleys and brigantines from the Bosphorus into the shallow water of the harbour, by constructing a level way, which was covered by a broad platform of strong and solid planks, rendered slippery by the application of tal-

low; and on which were drawn the vessels moving on rollers, just as masses of stone are now-a-days into the mason's yard.

"At the commencement of the seventeenth century, coals were conveyed from the mouth of the pit to the place of consumption in carts, and even in panniers on horseback, or, as we have seen them, some twenty-five years ago, in the neighbourhood of Ashby de la Zouch, on the back of the more humble, though not less Homeric, ass. But, as roads were not then, as they now are—thanks to the genius of a Macadam!—as hard as a diamond and as level as a die, they were soon cut up by the coal-carts, and in wet weather were nearly impassable. To remedy this inconvenience, *tram* roads were first constructed near Newcastle-upon-Tyne, about 1676. They were probably suggested by the unsuccessful experiments made by a Mr. Beaumont in 1646; who, after trying some plans for the better working of coal mines, and in conveying the coals in carriages of a novel construction, was ruined, like Middleton, the originator of the New River; and as Watt would have been, in all probability, had he not met with a powerful backer in his partner, Bolton. These tramroads consisted originally of wooden rails laid along the ground, made previously as level as possible. Upon these a machine, resembling a large box upon wooden rollers, and made to fit the rails, superseded the cart. The advantage gained by this simple contrivance was nearly thirty per cent. The regular load of a horse had been 17 cwt. previously; but he was enabled to draw upon the tramroad nearly 24 cwt. As the knowledge of mechanics became more generally diffused, and the doctrine of political economy, that time is money, more universally felt, various improvements were introduced in the construction of the wagons and rails. Amongst these is to be noticed the substitution of iron wheels for the wooden rollers of the wagon, and the adoption of cast iron rails, which were formed with a *flanch*, or upright ledge, to prevent the wheels from running off the track. The precise date of this change is not known. Several persons have laid claim to the invention; but from the books of the Colebrook-dale Iron Works, in Shropshire, it appears that some iron rails of that form were cast there for one of the partners, as an experiment, in 1767. It was found, however, that the flat rail, from its low position, accumulated extraneous matter, which formed a serious obstruction to the wheels. Hence the principle of the edge rail was adopted, which was fixed a few inches above the ground; and the flanch, to secure the wheel on the track, was transferred to the wheels of the wagon.

"Owing to the construction of the carriages, the horse (the only power then known) was unable to check the velocity resulting from the gravity of a descending body. Hence it was usual to detach the horse, and make him follow the wagon—a plan that led at once to the formation of a road upon a gradually descending plane, where the horse was required only upon the level portions of the line, and for drawing up the empty wagons to the summit of the ascent. But it was soon discovered that a check was requisite to impede the velocity of the descent. Accordingly, a break was introduced, acting by pressure upon the fore and hind wheels simultaneously; and which, being attached to a lever, was regulated by the attendant according to the speed at which he wished the wagon to descend. The action of the break was, however, irregular; for the rails were affected by the changes of the atmosphere, and especially in wet weather, when the wheels slid rather than revolved, from the want of a retarding rough surface.

"The next step was to dismiss the horse entirely, and to construct the road with two inclines, so that a descending train of loaded wagons might draw up an empty train, by means of a rope passing over a pulley at the top of the inclines. having its separate ends attached to the two trains. But, as the power of the loaded train was frequently too great for the weight it was required to draw up, a jerk was produced so as to snap the rope, or to cause the ascending train to bound off the rails; while, on other occasions, the power of the descending loaded train was insufficient to raise the requisite number of empty wagons. To meet the first difficulty, the friction was increased by the construction of multiplied wheels and pulleys; and to obviate the latter, a horse was employed to assist the power of the descending train.

"Here, then, from the operation of conflicting disadvantages, the rail road would have been at a stand-still, but for the discovery of the steam engine—that monster of human creation, which has more than realised the story of the hundred armed Briareus; and of which it has been said, there is nothing too great for it, nothing too small. Like the proboscis of the elephant, it can tear up an oak, or pick up a pin; can forge the heaviest anchor, and punch the eye of the finest needle; can twist the largest cable, or draw out a thread as delicate as the gossamer; can bore a cannon of the largest calibre, or form the shank of the smallest button; can drag a first-rate man-of-war against wind and wave, or flatten a mass of copper till it is as thin as gold-leaf.

"About 1760, and coeval with the introduction of iron rails (first adopted, it seems, by Mr. Carr, at the Sheffield Colliery), James Watt entertained the idea of employing steam as a moving power. But the design was speedily abandoned; nor was it until 1802 that the attention of engineers was again directed to locomotive engines* upon rail roads; when a patent was taken out, and the principle tested successfully at Merthyr Tydvil, in South Wales. But here again an obstacle presented itself, which has been only partially overcome, in the tendency which iron wheels have, when passing over a smooth surface, to turn round without progressing, and especially upon an ascent. To meet this difficulty, Mr. Blenkinsop invented a rack, continued along the whole distance of the rail, in which toothed wheels worked, and thus produced a progressive motion. Messrs. Chapman, however, adopted a chain, which was stretched along the centre of the railway; and being grasped by a grooved wheel and roller, at each stroke of the engine it was impelled forwards. Mr. Brunton invented two movable iron legs, each jointed, and terminating in a claw. These were placed behind the engine; and being acted upon by the piston, fixed themselves alternately in the ground, and drove the engine forward at each stroke. But as all such expedients only increased the friction, and diminished the power of the engine, they were eventually laid aside; especially after M. Blacket had proved, in 1815, that the wheels would progress on a railway, either level or with a slight rise, if the weight to be drawn was in a certain ratio to the moving power." Mining Journal.

* Towards the end of the last century, one Oliver Evans, of Pennsylvania, is said to have invented a steam engine, with which he first ground his flour, and, after placing it on a carriage, drove it to market; but, as he had a river to cross, he substituted paddle wheels for those of the carriage, which was made like a boat, and, after crossing, he unshipped the paddles and resumed the wheels. This account, which is to be found in the "Foreign Quarterly Review," is, we suspect, a history rather of what Evans said he would do, than of what he actually accomplished.

Asphaltic Mine in Pyrimont.

The following is an account of a very curious phenomenon, which has given rise to a production of the highest importance to the arts; I mean, the mine of asphalte of Pyrimont, situated at the foot of the eastern side of Mount Jura, on the right bank of the river Rhone, and one league north of Seyssel. In that locality, the surface of the ground is covered by molasse (siliceous gravel and bitumen), which extends from the banks of the river to the foot of the mountains, covering the last strata of the superior calcareous oolite, of which these mountains are composed. The molasse is intercepted by deep ravines, in which may sometimes be seen the "calcaire inférieur," which is frequently cretaceous, and belongs to the preceding oolitic formation.

At Pyrimont, a mass of calcareous asphalte, situated between two ravines, rises from the middle of the molasse on a surface of 800 metres long by 300 metres broad. This calcareous matter, the exterior surface of which is whitish, is internally of a deep brown colour, due to a certain quantity of asphalte with which it is saturated. The asphalte is, for the most part, equally diffused throughout the rock, yet some parts may be seen more or less saturated, and others in which the calcareous matter is quite pure; the disposition of the latter, would lead to the conclusion that the asphalte is ramified in veins in the calcareous mass buried under the molasse. The calcareous asphalte is not stratified; fissures are seen, which intersect each other in all directions, and divide it into irregular blocks.

In the surrounding molasse, the bitumen has penetrated in large veins; and in the excavation of this material, galleries have been formed, which follow their various sinuosities. The molasse is also impregnated with bitumen, absolutely in the same way as the calcareous substance, and as it is more porous, the quantity of bitumen is greater.

The rock which covers the calcareous asphalte, prevents the tracing of it to its junction with that which constitutes or composes the mountain, at the foot of which it is situated, and conceals the extent to which the calcareous mass is impregnated with bitumen. But in the same mountain, above Dorche and near Sauthonod, in the Val-Romey, is to be found calcareous schistose, also impregnated with bitumen, inserted between the layers of the corallien group. According to M. Millet, the bituminous schist contains impressions of vegetable remains, which are found also in the calcareous schistose that are not bituminous, of the same group. This fact proves that the bituminous matter, whatever may be its origin, has spread itself from the interior of the Val-Romey, to the banks of the river Rhone, passing through the rocks which it met in its passage at different epochs, and in different ways.

Our colleague, M. Millet, of Aubanton, who made the analysis of those bituminous rocks, of which we have just been speaking, has arrived at the following results:

1st.—The calcareous asphalte of Pyrimont, contains from 9 to 10 per cent. of bitumen, the remainder is carbonate of lime, nearly pure.

2d.—The bituminous molasse contains as much as 15 or 18 per cent. of bitumen, the remainder is micaceous sand, exactly resembling that which composes the molasse.

3d. The bitumen extracted from the two rocks, is identically the same. Tried with sulphuric ether, it gives a yellowish substance, which

burns with flame and smoke; it is soluble in essential oils, and insoluble in acids. By distillation, the oil of petroleum is obtained in very small quantities; acetic acid is formed in the operation; the residue is brittle, and fusible at a high temperature. The part which the ether does not act upon appears to be carbon; this, when heated in the air, burns with little or no remainder.

From these results, M. Millet concludes that bitumen is a compound—

1st. Of resinous petroliferous matter, ... 60 to 70
2d. Of carbon . . . . 30 to 35

Which would give the proportion of one to two between the resinous matter and carbon, a proportion which our colleague has found to be the same in all the analyses he has made. A great number of observations induces him to believe, that it is from the carbon that the black colour of the bitumen and its property of hardening in the air arises, which renders it so useful in the arts.

The bituminous matter being found both in the calcareous rock, and the molasse with which it is covered, it is evident that the action of the cause which has introduced it into these two rocks, succeeded the deposit of the latter; the way it is distributed in large masses, casting ramifications in various directions, and the superior parts generally containing less bitumen than the rest of the mass, shows that the bitumen has been sublimated or refined from the depth of the globe, through a fissure corresponding with the direction in which it is now observed; and that it condensed itself in the superior rocks, the heat having dilated or expanded the porés, which, by contracting themselves in cooling, might have rendered the combination as close as now seen. The nature of bituminous rocks (molasse, calcaire-crétacé, et schiste-calcaire) adapt themselves to this kind of action. The molasse and the calcareous rock are so porous, that they readily imbibe water; the calcareous schist also adheres to the tongue. It is therefore probable, that these rocks have easily been penetrated by the bituminous vapours, which most likely spread themselves over all the three at the same time.

The epoch of the introduction of the bitumen into the preceding rocks being necessarily of a subsequent date to the deposit of the molasse, one may presume that it corresponds to that of the basaltic eruptions, which, it is clearly proved, by several facts, have often been accompanied with bituminous substances: it is at the same epoch that the Alps and Mount Jura must have experienced the last commotion which has changed their form, by breaking the rocks, whose fragments, at this day, compose those enormous masses, which are covered over only by the deposits of the present era. It may be objected, that no basaltic rock is to be seen in the whole range of the mountains of Jura. To that I reply, that some are to be found in its neighbourhood, in Burgogne and in the Vosges; besides, it must be observed, that in order to cause changes on the surface of the ground, either by fractures, or by the disengagement of vapours, it is not necessary that the plutonic rocks should appear outwardly. It may happen, that in the bottom of the valleys of Jura, the basaltes are at a small depth.

The phenomenon of rocks impregnated with asphalte, is not confined in Mount Jura to those localities we have just quoted; many are also to be found in several other places on the eastern side, and particularly in the Val-Travers, near Neufchatel, but they are not so well developed as

in the neighborhood of Seyssel, nor have they acquired the same importance in the arts.

I have seen in the possession of M. Brongniart, specimens of the calcareous asphalte of Val-Travers; it resembles very much that of Pyrimont, and a fragment, of which a very small portion is impregnated, has shown me again, that it was the porous calcaire of the corallien group.

The calcareous asphalte of Pyrimont is seen on the surface of the ground, in a space circumscribed by the molasse, of 800 metres in length and 300 metres in breadth. The thickness of the mass has not yet been ascertained, but it appears to be considerable. The mass is openly worked, large blocks are extracted, which are afterwards broken to pieces.

The bituminous molasse is worked by galaries following the sinuosities of the veins: when carried to the (usine) depôt, it is broken into pieces of the size of an egg, which is refined with boiling water, to extract the bitumen from it.

The calcareous asphalte is reduced to powder, that it may be more easily mixed with the bitumen.

In the preparation of the mastic, ninety-three parts of calcareous asphalte is mixed with seven parts of bitumen, extracted from the molasse; the whole is exposed in furnaces or cauldrons, for a long time, to the action of fire; when quite fluid, it is poured into moulds of any shape that may be required, to render it portable. Many attempts have been made to imitate the mastic of Seyssel; and as a substitute for the calcareous asphalte, they have employed other substances, which absorbing from 40 to 50 per cent. of bitumen, gives a composition which the heat of the sun melts, and which, when exposed to cold, cracks. And in some cases, they have employed substances, which having no affinity whatever for bitumen separated by time.

The genuine mastic, which is melted on the spot where it is used, in a few instants after it is poured into the mould, becomes so very hard, that at a temperature of more than 30° Reaumur, = 100 Fahrenheit, it will receive no impression, yet it retains a certain degree of elasticity, whereby it adapts itself (or stretches) without breaking, to all the motions which the masonry, or roof, &c., where it is applied, undergoes.

The mastic of asphalte is employed for covering terraces, roofs of buildings, footpaths of bridges and streets, arches, cellars, and interior areas, &c.; also in the construction of aqueducts, basins, and all kinds of hydraulic works. It has been used to cement stones, bricks, and even metals.

Many works have been executed in Paris and its environs, with the mastic of Seyssel; for instance, the footpath on the Pont Royal, and that of the Louvre; trials which have so well succeeded, that the authorities of the city have decided to adopt the same materials for the footpaths of the streets, also of the Place de la Concorde (formerly called Place Louis XV.) which is about to be laid out on an extensive and grand scale.

The magazine of provision at Bercy, has been covered for upwards of a year with this mastic, and succeeds perfectly.

In the years 1832, 33, 34, this mastic was, with equal success, employed in the construction of the military works at Vincennes.

It has also been successfully employed in the military constructions at Douai, Besancon, Bourbonne-les-Bains, Grenoble, and Lyons. In the

last city, all the covering of roofs and the interior areas of the new forts have been constructed with it.

More than forty years ago, at Fort l'Ecluse, a small building was covered with this mastic, which has ever since continued in a perfect state of repair.

The asphaltic mastic, the nature of which now begins to be generally understood, will render peculiar advantages in architectural constructions.

The working of the asphaltic rocks of Pyrimont, is traced back as far as 1790, but whether the product has been little known, or whether from ignorance of its application, the mine remained in a state of stagnation till the year 1818, from which time to 1820, the annual sale rose to 200,000 kilograms. The improper application of the mastic, together with the want of sufficient capital on the part of the company who were working the mine, retarded their operations; but for the last six years, the owner, the Count de Sassanay, who resides on the spot part of the year, having devoted his attention to the subject, the working of the mines has increased to a great extent. In the year 1835, the sale of the mastic exceeded a million of kilograms, and bids fair for a continued increase.

Count de Sassanay has constructed at Pyrimont a very elegant place for the preparation of the asphaltic mastic, and devotes the whole of his attention to the perfection of the process employed in its manufacture. The importance which the use of this material of Seyssel will give to the constructions at Paris, must justify in the eyes of the society, the details into which I have entered, with regard to that substance.

Mining Rev.

On Iron best suited for Railways; by David Mushet.

The following conclusions at which I have arrived on the important subject of the nature and habitudes of malleable iron, particularly that adapted to railway purposes, are the result of many experiments, and of forty years unremitted application to iron making.

1st. I consider that a crystalline arrangement of the fracture of bar iron is incompatible with great strength and fibre, and that it is essential to railway iron that it should be hard and fibrous.

2nd. The more frequently iron is heated or melted in the course of its progress towards its completion as bar iron, the greater is its tendency to crystallize and become brittle when cold. This is in some measure prevented by repeated rollings; but fibre acquired in this way is to a certain extent artificial, for where native fibre is absent, heating and cooling will restore the crystalline arrangement and weaken the tenacity of the iron when cold.

3rd. Excessive decarbonization, commonly called refining, which tends to deprive the iron of its last portion of carbon, produces a quality of malleable iron, soft, and easily abraded by rubbing or friction, and therefore, in point of durability, not well calculated for rail iron.

4th. Conversely, iron manufactured so as to retain the last, and consequently, the most intimately united portions of carbon, or to have this substance communicated to it in minute portions in working, is upon two accounts better calculated for rail-making (provided the fibre

is not injured) because it will wear less by rubbing, and be subject to less waste by oxydation.

5th. Bar or malleable iron has a tendency to crystallize in the cooling, in proportion to the size of the manufactured mass, a circumstance deserving the greatest consideration on the part of the engineer in determining the form or shape of his rails.

6th. Continued vibration, such as is produced by the motion of an engine or wagon traveling on a railway, causes iron to crystallize, and to a certain degree become brittle. Hence the importance of making rails from iron full of fibre, so as to postpone the time of crystallization to as remote a period as possible.

7th. Unless impaired or destroyed, by the repeated heatings and fusions to which iron is subjected in the progress of its manufacture, the quantity and strength of fibre developed, will mainly depend upon the proportion of carbonaceous matter, originally contained in the pig-iron from which it is manufactured.

8th. It is essential in rail making, to have a quality of iron, which, without dropping or opening at the rolls, will stand a degree of heat capable of compactly and adhesively welding the piles together so as to prevent exfoliation or separation of the parts when subjected to rail-road traffic.

Considering the foregoing conclusions to be well founded, it has often been to me a matter of surprise, that the two most important qualities of iron for rails, namely, fibre and hardness, have seldom or never formed a condition in any railway contracts for rails. Certain manipulations or stages of operations, which may be necessary in making iron for smiths, or indeed for general purposes, are usually stipulated for without its being taken into the account, that the properties required in railway iron may be quite the reverse. The consequence of this oversight, has been to withdraw the attention of the manufacturer from these important desiderata, and induce him to follow the letter of the engineer's specification as to process, leaving the properties of fibre and hardness to the chapter of accidents.

The present process of bar iron making, is in some measure incompatible with the production of the above mentioned requisites for railway iron, and this may serve to account for the difficulty of obtaining fibrous masses, such as rails of 60 to 75 lbs. per yard, as well as for the want of hardness in the body of the rail itself. The whole process is one of severe decarbonization. The pig iron for the refinery is in most situations chosen with as small a portion of carbon as will enable it to melt. In this furnace, in order to separate about 4 per cent. of carbon, manganese, silica, &c., from 12 to 15 per cent. of the whole quantity of iron is lost, by being converted into a slag or scoria of a most deleterious quality. After the pig iron has, by melting, passed under the blast, and penetrated the body of cinder, it is then literally set on fire by the action of the blast pipes on its surface, and the decarbonization is carried on, not by fermentation as in puddling, but by a true combustion of a part of the iron, and by a change of surface produced by an alteration in the specific gravity of the particles of the iron. Should the quantity of refinement have been limited, the new arrangement resulting from the fusion of the iron, in so high a temperature, will be found unfavourable to fibre in the ultimate result. So, that to produce any certainty in this respect, it becomes necessary to prolong the refinement

until a new and steelly arrangement takes place, and this arrangement of the iron in running from the furnace, is indicated by the extreme levity, intense combustion, greater waste, and a porous, or honey-comb, fracture of the metal when cold.

This commixture of crude iron and steel, is again melted by flame in the puddling furnace, where it undergoes, by the addition of cinder, a process of fermentation, which carries off the last portion of carbonaceous matter, and leaves the iron comparatively soft when cold.

The reverse of this takes place in the manufacture of charcoal iron. In this operation, the pig iron, during the single process which converts it into malleable iron, is always in contact with fuel. This prevents that total decarbonization which takes place with puddled iron that has passed through the refinery. Hence the superior hardness and tendency towards steel in Swedish and Russian iron.

To the subject of fibre, my attention has for some years been directed. At various times I have made numerous experiments, and it has been gratifying to find, that the same means employed to obtain fibre, to a certainty produced a superior degree of hardness and durability, and altogether avoided the process and waste of the refinery. In the method I have adopted (and for which I have lately taken out a patent) the charge of pig iron is at once introduced into the puddling furnace, where it is subjected to an imperfect, though uniform, fusion, the temperature being no more than is barely necessary to melt it. In this state a portion of finely ground rich iron ore, as a substitute for cinder, is from time to time thrown upon the iron and worked into it by the puddler. In a short time considerable fermentation takes place, and gas is evolved. In twelve or fifteen minutes pig iron of the most crude and fusible description, is converted into malleable iron, which appears in a flakey and divided state. The heat being increased, the iron coaleses and is formed by the puddler into what are called balls of puddled iron. These are, in the usual way, taken to the hammer or rolls, and elongated into bars called No. 1, or puddled bars. These again are cut into certain lengths, piled upon each other and re-heated, and for the purpose of railway iron rolled into broad bars or slabs, known by the name of No. 2 iron. These in their turn, are either piled alone a second time, or mixed with narrower iron, re-heated and rolled into rails in that state, which is called No. 3 or best iron.

The quantity of iron ore required to decarbonate the pig iron, depends upon the fusibility of the latter, and varies from one-tenth to one-twentieth the weight of pig iron; and the fusibility principally depends on the quantity of carbonaceous matter contained in the iron, which is as various as the numerous shades between white iron and dark grey foundry iron.

By following this process a considerable saving of pig iron is effected at a very trifling increase of expense for ore, and additional labour beyond the expense of the usual mode of working. This is one great advantage of the process, but the most important consists in being able at all times to develop, in the first stage of the manufacture, a certain quantity of strong fibre, which is increased during the ulterior operations, and conjoined with great hardness.

Iron ore when used in the puddling furnace, whether with pig iron or with refined metal, decarbonates the iron by means of oxygen which it presents to the carbon united with the iron, and at the same time it calls

into existence an unusual display of fibre. This remark applies as well to refined metal as to pig iron, and no degree of fusibility on the part of the pig iron retards the full and beneficial effect of the iron ore, provided it be applied in proper quantity.

I consider pig iron, and not refined metal, as the true source of strength, hardness, and fibre in bar iron, particularly when cold, and as these qualities can at all times be obtained by a judicious selection of pig iron, and the use of iron ore, we may consider ourselves in possession of a method by which these three great requisites to the production of railway iron are secured. I have only further to remark, that it is probable the piling and rolling in the first instance may be done away with in the making of railway iron, by hammering the puddled balls into large and solid blooms, to be afterwards rolled into rails. By following this line of operation, the great evil of lamination, as it is called, or a separation of the piles, hitherto so injurious to durability, would be got rid of.

Lond. Mech. Mag.

On Captain Huddart's Improvements in Rope Machinery. *By* W. Cotton.

The attention of the late Captain Huddart was directed to the subject of rope-making, from observing every morning during a voyage, that some of the external yarns of a ship's cable were broken.

This was evidently to be attributed to the additional strain which the outer yarns experienced in the process of twisting, the yarns being all originally of the same length. It was proposed to obviate this defect by giving to all the yarns an increased length in proportion to the distance of the yarn from the centre of the strand, and to the angle at which it was laid. The success which attended these efforts induced Captain Huddart to construct the large laying machine, which was found to answer completely, and to give each strand its proper length and proper degree of twist, and to preserve throughout the longest rope the same press and the same angle.

The paper contains some historical notices respecting the establishment of the extensive works of Huddart and Co., at Limehouse, and the various stages of improvement. Several pieces of strand, to illustrate the foregoing principles, were presented, as also a piece of the twenty-two-inch cable made for the East India Company's ship Waterloo; a strand of the long rope made for the London and Birmingham Railway; and some cards containing the comparative strength of the warm and cold, registered and common, cordage.

The distinguished individual of whose improvements in rope machinery a brief account has been here given, was born at Allenby, in Cumberland, in 1741, and died in 1816, after a life devoted to the pursuit of those scientific researches for which his rare talents so eminently qualified him.

In the strands, as constructed on this principle, the strain on all the yarns will be the same so long as the original degree of twist is preserved; but if the strand becomes untwisted, there is an extra strain on the internal yarns; if more tightly twisted, on the external yarns; several strands, however, being worked together in a cable, the twisting or untwisting of each particular one is prevented.

Trans. Civil Engineers.

Note on foundations upon sand; and on coatings of mineral tar: by M. Olivier, *engineer of Roads and Bridges.*

Translated for the Journal of Franklin Institute, by J. Griscom.

1. *Foundations on Sand.* At the school *des Ponts et Chaussées,* in 1830, it had been pointed out to us, that foundations on sand might be laid, wherever the earth was compressible, and in no danger of being carried away by floods. The canal of Saint Martin was given as an example. I have several times applied the system thus indicated and always with success. The following are examples: M. Dupuis, one of the conductors in my district, an architect of the town of Pont-Auderner, was employed to erect a building for the mayoralty. Its situation required that the edifice should be founded on the natural soil. This was well, for there is, in the valley of the Rille, a little below the soil, a bed of solid stones, mixed with sand, of about 31½ inches thick. M. Dupuis, feared that the ground under the bed of gravel was not good, and he had it sounded. It proved to be compressible, and when the gravel was removed, it became impossible to lay a good foundation on the earth which it covered. The architect deemed it needful, in consequence, to resort to piles, and these, it was ascertained, must be very long to reach solid ground. I went to see the work as they were beginning to drive the piles: it was a very expensive undertaking, which I proposed they should avoid, by substituting a bed of water sand, well watered with cream of lime. M. Dupuis, being responsible for the work, could not decide upon taking this advice, and continued the piles sufficiently for the whole front wall; but he adopted for the other walls the plan I had recommended. These were all, of course, united, though resting on different foundations, but they have all remained firm without any movement, or at least it has been uniform.

This furnishes a new proof of the safety of foundations on sand; 1st, since all the erections in the valley of the Rille, founded on the bed of gravel before mentioned, stand very well, though the ground underneath is compressible; 2nd, since the walls placed on sand, resting on soft ground, have not sunk more than those built on piles, driven with the greatest care to a solid foundation.

Another fact. M. Fauquet Lemaitre, is a proprietor, at Bolbec of several cotton factories. One of them being burnt down, he extended the other, which made it necessary to connect the new with the old walls: these walls, situated at the foot of a hill, were partly on a mass of chalk and partly on a bottom of green sand, in spaces where no chalk existed. This sand was moistened by infiltrations of water, which could not however wash it away. When a weight was placed on this sand and left at rest, the mass remained firm; but if a little motion were given it, it became pasty and almost liquid. The builder thought he must have recourse to piles, and several foundations were prepared for their being driven, when M. Fauquet spoke to me about his buildings, and of the position in which he found himself. At this time, the experiment before cited had been made, and I advised him to lay his foundations on sand. I requested him to converse with M. Frissard, chief engineer at the Port of Havre, and he did so. The latter coincided with me, and added that all the masonry of the steam engine of 60 horse power, was founded on sand, and nothing had moved it. It was not so with the struc-

tures on piles; a side wall, connected with the foundationof the engine, placed on piles driven as deep as possible, had moved so much that the connecting stones were broken, so that they had to saw them off from the engine walls, the level of which had not changed. This accident, it was believed, occurred from the water contained in the sand, having collected more abundantly around the piles; and the friction of the latter against the ground, being thus diminished, they sunk until the masonry rested on the sand.

As other walls erected on sand or on rocks, have not moved, this experiment proves that foundations on sand are as safe as those on rocks, while we cannot rely upon the stability of an edifice constructed on piles and driven into sand; the friction which they encounter induces the belief that they have gone as far as possible, or necessary, and when any cause diminishing this resistance from friction occurs, an accident follows which proves the contrary.

The first experiment was made under my own eyes; the second I did not witness, but have every reason to believe that a true account was given me.

2. *Employment of mineral tar in structures of masonry.* It has for a long time appeared to me that mineral tar, which does so well upon wood and iron, might also be used for covering stone and brick work, as a defence against moisture. Four experiments were made which confirmed this apprehension. But it will be well to premise that as mineral tar is obtained by distilling vegetable materials, it would be more suitable to call it pyroligneous tar.

Without touching upon all the cases in which pyroligneous tar may be employed, which we believe to be very numerous, we shall simply cite a few in which we have tried it.

The light house of Quillebuef had become much degraded by North East storms. The rains were very copious, and the water passing into the brick tower, caused the bottom of the stair case to rot. We repaired the masonry, and in the month of May 1833, painted the tower with pyroligneous tar, which so far has perfectly answered our expectations; excepting that a few of the pilots pretend that the light house, being now black, is not seen so well as when it was white.

M. de Cachelu painted with the tar an earthen wall, exposed to the rains so much as to become very wet inside the building. When I saw these walls, the tar had served as a complete defence against the dampness.

Walls much exposed to storms of rain, are commonly defended by a coating of slate or cement, but the above experiments shew that these two modes of defence may be advantageously replaced by a coating of pyroligneous tar.

The joints of the wall being well filled up and smooth, the tar is spread over it and it penetrates the wall. When dry, a second coat is applied and immediately powdered over with sand. This, when solidified, is covered with lime white wash, as thick as can be put on with a brush. This, acting on the carbonic acid of the atmosphere, forms a crust of limestone which exists for a long time, and once in two or three years the wall may be re-white-washed.

We have employed this treatment on bridges very successfully.

In courts, and yards, and terraces, the tar coating is now employed with great advantage. When worn or broken it is easily repaired.

Annales des Ponts et Chaussées.

Mechanics' Register.

Progress of Railways in England.

In the course of three years, 1500 miles of railway will, in all probability, be executed in England alone, and, calculating the average cost, inclusive of engines, at 20,000*l* a mile, 30,000,000*l*. will have been spent in carrying them into execution. It is an unprecedented advance in the improvement of intercourse, and it is a plain speaking fact of the estimation in which this mode of travelling is held by the nation, both as an investment and as an improvement on the old system. England is not, however, the only country in which railways have made such rapid strides.

Lond. Mech. Mag.

Patent Furnace for Consuming Smoke.

On Friday, the 20th, inst., in Messrs. Vernon and Company's boiler works, was exhibited a most successful trial of a full-sized locomotive fire-box, constructed upon a plan for burning smoke, for which Mr. John Gray, of the Liverpool and Manchester Railway Works, has taken out a patent. We congratulate Mr. Gray upon having made such an important discovery, which must necessarily be a source of great profit to himself, as well as incalculable benefit to the public. We acknowledge that we had been rather sceptical on the subject of burning smoke, inasmuch as all the plans which we had previously seen in operation for this purpose, have been more or less liable to objections which have militated against their general practicability, but in this case there is nothing arising out of its construction in either expense, danger, or complexity, which can operate against its universal adoption, but on the contrary, the smoke was most completely consumed upon a simple, cheap, and safe plan. It is applicable either to locomotive, marine, or land boilers, and we have no hesitation in predicting that it will soon be in general use. Upon a fair calculation, it appears that the Liverpool and Manchester Railway Company, alone, may save by it upwards of 6000*l*. a year, by substituting coals for coke, which they are at present compelled to use in order to dispense with smoke. In marine or land boilers, the saving must also be enormous, by burning those dense clouds of smoke which, in ordinary cases, are suffered to escape at the chimney tops, thus rendering available the vast accumulation of carbon which it contains. Two locomotive engines are now in progress of being made by Messrs. Thomas Vernon and Co., with fire boxes upon this plan, which are intended to burn coals instead of coke, the success of which we deem quite certain.

Min. Journal.

A method of breaking Ice by forcing it upwards instead of downwards; practised on the Herefordshire and Gloucestershire Canal in the Winters of 1834, 1835 *and* 1836; by STEPHEN BALLARD, A. Inst. C.E.

Mr. B. places strong planks covered on their upper side with sheet

iron in the front of a boat, so as to form an inclined plane pointing downwards, the lower end of which goes under the ice. The boat, drawn by a horse, is steered by a person walking on the shore with a long shaft attached to a pole projecting over the stern. It is believed that one boat, horse, and boy, would thus break much more ice than three boats worked in the usual manner.

Journ. Arts and Sci.

Eye Shaped Windows.

The peculiarity of this place, and which kept us laughing at the recollection for nearly a mile after we left it, was the windows in the roofs of the houses. They are shaped exactly like eyes: the tiles swell up gradually like a lid above and below, elongating towards the end; and in the oval space between these twinkles the little bright window pane, just in the place of the pupil. It was, in fact, as exact a model of the human eye as could be made out of such materials. I never saw any thing so funny. The whole village had an *eveille* Argus-like look, that was irresistably droll; all the houses laughing, and blinking, and peeping at us as we drove in. The shape being long, and the lower lid rather straight, gave them a sly, sleepy, half closed expression, and, withal, a look of fun and merriment, as if the house were "holding its sides" with laughter. Sometimes we came to a great Cyclops building, with its one staring optic in the middle of the roof; and then appeared a comical intelligent looking thing, with a pair, that twinkled and screwed themselves up at us as we passed, in the most provoking and impertinent manner possible. It was really too bad. (*A Lady's Souvenirs of a Tour in Germany.*

Arch. Mag.

Frozen Ground of Siberia.

The whole of the Northern Siberia presents the singular phenomenon, that, even in the hottest season, the soil remains frozen from a certain depth downwards, differing according to the latitude, and other local circumstances, and that the thickness of this frozen stratum is so considerable in the more easterly places as for instance, at Jakutzk, that its bottom has not yet been reached. Gmelin relates that in the archives at Jakutzk, he found an account of an inhabitant of that town having, at the beginning of the last century, together with some Jakuters, contracted to sink a well, and that, when they had reached the depth of ninety feet, finding the earth still frozen, they refused to fulfil their engagement. Some philosophers have considered this contradictory to the supposition that the interior of the earth is in the state of fusion. But from the following account it will be seen that, in those frozen strata, the general phenomenon of an increase of temperature with the depth is not wanting, and that by continuing the work, they have arrived at a temperature which leaves no doubt that they are not far from the lower limits of the frozen soil, and that water, the object of their undertaking, is not far distant. An article from St. Petersburg, in the Berlin News of the 24th February, 1832, states that at Jakutzk,

in Siberia, the earth, even in the hottest summer, only thaws to about the depth of three feet. Hitherto all attempts to discover the thickness of the frozen strata beneath, have been fruitless. Since the year 1830, one of the inhabitants of Jakutzk has been engaged in sinking a well, by which means it may perhaps, be ascertained. In the same year the workmen reached the depth of seventy-eight feet below the surface, but still found no water. In the year 1831, they reached ninety feet, and were still in the frozen soil. The work is still in progress, and there seems no doubt of their attaining their object, for the thermometer, which showed 18 deg. 5 min., a few feet below the surface, rises, when sunk to the bottom of the well, to 29 deg. 75 min.—*Edin. Phil. Journ.*

Min. Jour.

Condensation of Moisture on Optic Glasses.

The condensation of moisture which is apt to take place upon the object glasses of telescopes in the atmosphere of the evening, may it is said, be obviated by the employment of a tube of pasteboard 12 or 18 inches in length, so constructed as to fit upon the object end of the instrument. The invention, is ascribed to the celebrated astronomer De la Hire.

Lond Mech. Magazine.

LUNAR OCCULTATIONS FOR PHILADELPHIA, DECEMBER 1838.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
2	16	14	Im. *c* Aurigue	6	102	162
2	17	18	Em.		233	293
4	9	24	N. App. ☽ & λ Cancri 6 ☽ S. 0.'3			
21	4	48	Im. 50 Aquarii	6	55	62
21	5	10	Em.		21	84
24	9	34	Im. ι Piscium	4	105	148
24	10	39	Em.		319	7
26	13	39	Im. 47 Arietis	6	152	206
26	14	18	Em.		237	290
27	7	24	N. App. ☽ & *b* Pleiadum, 4,5 ☽ S. 2.'2			
27	7	17	Im. *d* Pleiadum	5	119	70
27	8	33	Em.		293	267
27	8	25	Im. (151) Pleiadum	7	167	138
27	9	13	Em.		244	244
27	7	59	Im. η Tauri	3	124	85
27	9	17	Em		286	286
27	8	54	Im. *f* Pleiadum,	5	77	64
27	10	0	Em.		327	353
27	8	54	Im. *h* Pleiadum,	5, 6	94	81
27	10	11	Em.		309	341
30	16	32	Im. 47 Geminorum	6	86	145
30	17	31	Em.		238	295

Proposed mode of obviating the dangers which now exist in carrying on the works of that ill-fated undertaking, the Thames Tunnel.

Let a raft or deck, be constructed of massive timber, and caulked similar to a ship's deck; this raft must be 30 or 40 feet wider than the Tunnel, and sufficiently long to cover that part of the bed of the river immediately over the part of the Tunnel where operations are being carried on: by laying a sufficient weight upon the raft, it could be sunk and imbedded into the bottom of the river, so as to form, I think, a complete protection to the workmen underneath. The irruptions which have taken place proceed, I believe, from two causes; first, from the loose nature of the soil composing the bed of the river; and, secondly, from the immense pressure of the great body of water; the raft would undoubtedly counteract the evil of the pressure of water, and if sufficiently imbeded into the bottom of the river by heavy weights, would, I think, become sufficiently water-proof to enable the workmen to excavate to the bottom of the raft, if necessary, without the fear of inundation. When that part of the Tunnel was completed over which the raft was placed, it could be removed by the following simple means.

Let an iron ring be strongly inserted at each corner of the raft, at low water. Chains could be easily attached to these rings; then tightly moor a lighter to each chain; and as the tide rises, the raft would also rise, and could be easily lowered over that part of the Tunnel next in operation.

Lond. Mech. Mag.

Meteorological Observations for June, 1838.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
☾	1	56	82	29.85	29.[illegible]5	SW.	Brisk.	.27	Clear—rain.
	2	62	76	80	85	W.	do		Partially cloudy—clear.
	3	62	78	80	80	W.S.	Moderate.		Clear—do.
	4	68	74	80	75	S.	do.	1.00	Fog—rain.
	5	62	73	40	40	NE.	do.	.95	Cloudy—rain
	6	60	67	44	44	N.E.	do		Partially cloudy—do. do.
	7	56	73	40	50	W.	Brisk.		Cloudy—clear.
	8	60	84	80	80	W.	do.		Clear—do.
☉	9	64	86	30.00	30.00	E.W.	Moderate.		Clear—do.
	10	56	88	00	00	W.	do.		Clear—do.
	11	68	88	29.95	29.95	W.	do		Clear—do.
	12	68	88	90	90	W.	Brisk.		Clear—do.
	13	70	90	86	86	W.	Moderate.		Clear—do.
	14	70	88	90	90	W.	do.		Clear—do.
	15	70	87	95	95	S.W.	Brisk		Clear—do.
☽	16	68	83	95	95	S.W	do.		Clear—flying clouds.
	17	76	85	85	60	SW.	Moderate.		Cloudy—clear.
	18	69	85	60	60	N.E.	do.		Cloudy—do.
	19	58	70	30.00	30.00	N.E.	do.		Clear—do.
	20	50	77	5	5	E.	do.		Clear—do.
	21	61	80	29.95	29.95	S.W.	do.		Cloudy—clear.
	22	68	86	86	83	S.W.	do.		Clear—flying clouds.
⊗	23	68	91	80	80	S.W.	do		Clear—do.
	24	68	78	78	70	S.	Calm.	1.20	Showery—heavy thunder—shs.
	25	68	80	70	70	S.W.	Moderate.	.28	Clear—rain.
	26	61	80	75	80	W.	Brisk.		Clear—do.
	27	63	80	96	96	N.W.S.W.	Moderate.		Clear—lightly cloudy.
	28	68	76	80	75	W.	do.	.03	Cloudy—showery.
	29	68	83	78	78	W.E.	do.		Clear—do.
	30	69	80	78	80	S.E.	do.	.28	Cloudy—showery.
	Mean	62.80	81.60	29.81	29.81			4 01	

	Thermometer.	Barometer.
Maximum height during the month.	91. on 23d.	30.05 on 20th.
Minimum " " "	50. on 20th.	29.40 on 5th, and 7th
Mean	72.20	29.81

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Practical and Theoretical Mechanics and Chemistry.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the liquefaction and solidification of Carbonic Acid.

By J. K. Mitchell, M. D.

In the year 1823 public attention was strongly drawn to the subject of the liquefaction by pressure, of the, so called, permanent gases, by Mr., now Sir Michael Faraday.* Among the ærial fluids, carbonic acid was distinguished as requiring a force of 36 atmospheres at 32° F. to coerce it into the liquid state. His ingenious and hazardous experiments were conducted in glass tubes; and he depended on the accumulation of newly generated gas for necessary pressure.

Mr. Brunel,† in a subsequent endeavour to apply compressed gases to mechanical purposes, produced a pint and a half of liquid carbonic acid, which, even at high temperatures, he confined in a series of small brass tubes not above the $\frac{1}{10}$ of an inch in the thickness of their walls.

This interesting subject was not again publicly agitated, until the appearance in December, 1835, of a report on the liquefaction of carbonic acid on a comparatively large scale. In the last number for that year of the *Annales de Chimie et de Physique*, M. Thillorier described the properties of liquid carbonic acid in detail. According to him this liquid demands for its existence as such at 32° F., a pressure, as stated by Sir M. Faraday, of 36 atmospheres. Its specific gravity is at the same temperature 0.830, at —4°F.—0.900, and at 86°—0.600. It is therefore enlarged by heat 3.407 times as much as its own or any other gas, when carried from 32° to 86°. From —4° to 32° its expansion is almost exactly equal to that of the gases.

M. Thillorier found also that the expansive force is altered by heat so as to amount at 86° to 73 atmospheres, and at —4° to 26 atmospheres. The density of the gas when resting over the liquid at 86°, is stated at 130 times the density of that which is compressed by the force of one atmosphere. Its pressure is therefore at 86° not much more than one-half of that which its density would indicate.

When liquid, the carbonic acid is, on the same authority, immiscible with

* Philos. Trans. Lond. † Quart. Journ. vol. XLI.

water and the fat oils, but is readily united with ether, alcohol, naphtha, oil of turpentine and carburet of sulphur. Although potassium decomposes it, lead, iron, copper, and the other easily oxidized metals, do not act on it.*

The theometric temperature observed in the jet by Thillorier, appears to be erroneously stated; for, as the *solid* is, at its formation, not below —90°, and as the act of solidification of any vapour or liquid keeps the temperature, for the time, at the highest point compatible with the existence of the particular solid under observation, it follows that the jet of carbonic acid cannot fall below its freezing point. Immediately after its production, the carbonic snow begins to grow colder, and may be made to reach —109° in the air, —136° under an exhausted receiver. When moistened with ether, it can be depressed to —146°. Professor Hare's ether acts much more effectually than sulphuric ether.

At the immediately subsequent sitting of the Academy of Sciences, Thillorier announced the important fact that he had solidified carbonic acid. This he effected by suffering the liquid to escape into a bottle, or box, where by the sudden gasefaction of a part, the remainder was frozen by the extreme cold thus produced. The solid is white, light, evaporable and excessively cold. Because, surrounded by an atmosphere of gas which is constantly escaping from it, a fragment of it touched lightly by the finger glides rapidly over a plane surface.

Its evaporation is so complete as to leave no other trace of moisture than that which is caused by the coldness and consequent atmospheric humectation.

The force of its gasefaction is alleged to be equal to, but not so sudden as, that of gunpowder.

The temperature at which the solidification took place was presumed to be about —148°F; although the experiments before the committee of the Academy shewed —124°.

Such is, in substance, the account by M. Thillorier of his novel and curious discovery, reported in the *Annales de Chimie*. No description of the method of procedure, or of the apparatus used, is annexed; and we are left to conjecture, and to the imperfect description of travellers, for any farther knowledge of either.

Having repeated the experiments of Thillorier, I deem it not useless to subjoin a draught of the instrument with which, aided by the suggestions of an intelligent pupil in France, and the assistance of friends here, I was enabled successfully to repeat most of the experiments of Thillorier and to verify some, and correct other, of his results.

The apparatus consists of a generator of cast iron, A, supported by a wooden stand, B, a receiver, F, also of cast iron, connected to the generator by a brass tube, and fastened firmly to it by the stirrup screw, K,—H, I, J, are stop-cocks, G the nozle of a pipe, L a glass level-gauge, and S, M, R, a pressure-gauge.

The generator is 20 inches long and 6 inches in diameter exteriorly. Its cavity is 16 inches deep, and 3 inches, nearly, in diameter, so that it will hold about 4 pints. The walls are, of course, about 1½ inches in thickness. At the top an aperture of two inches in diameter is closed by a strong wrought-iron screw, the shoulder of which is let in about a quarter of an inch. The

*Among the most remarkable of the phenomena observed by Thillorier was the intense cold produced by the sudden liberation of the liquid and its conversion into gas. A jet of it depressed the thermometer to —130F., and when sulphuric ether had been previously mixed with the liquefied gas, the refrigerating effects were more marked both on mercury and the sensations.

collar is of block tin turned to the size of the shoulder of the screw. There is a hole in the head of the screw E for the reception of a long, strong, iron bar.

The copper cup, N, 1¼ inches wide, and 9 inches long, holds about 12 fluid ounces. There is a little handle at the top, and a copper wire at the bottom which make the whole length a little less than that of the cavity of the generator. This cup is used to introduce the sulphuric acid.

The brass tube between the generator and receiver is divided into two parts of equal length, which admit of being united by means of a conical juncture, kept tight by the stirrup and screw, K, K. Each of these portions of the tube may be closed or opened at pleasure by a stop cock. One is placed at I, another at J; so that when the receiver is being separated from the generator, the contents of both may be retained. The stop-cocks in common use are inadequate to resist the pressure, and therefore a screw stop-cock is indispensable. It is made to close a small aperture by means of a conical point, and having a double cone, it closes an outlet also when the cock is completely open, so as to prevent the escape of gas by the sides of the screw.

The receiver, F, is of the capacity of about a pint. The pipe, G, G, turned at a right angle at G, descends so as almost to touch the bottom of the cavity in F. The stop-cock H, G, is similar to I and J. L is a glass tube connected at each end to a socket of brass, which communicates with the interior of F. It is the gauge for observing the level of the liquid in T.

The gauge for measuring the pressure is peculiar. Into a wrought iron box, S, are inserted, by screws, two sockets, T and U. The former descends almost to the bottom of the box, which is nearly filled with mercury. Through the axis of the screw, X, a small tube passes into the cavity of S, and is continued to the top of it, so as to rise above the mercury. Two strong barometer tubes, R and M, are cemented* into U and W, and hermetically sealed at the upper ends. These tubes are carefully graduated. In one of them, U, a short cylinder of mercury is made to stand at Y at the commencement of the experiment. The other, socket and all, is full of air, as no mercury is introduced into it. A very fine screw at W, enables the operator to regulate the quantity of air in T.

The tin cup, O, used to collect the solid acid, is covered by a lid, Z, perforated by a pipe, P, whose top is full of small holes. The handle Q, is hollow, so as to fit the end of the pipe of the receiver at G. To secure the hand of the operator from the cold produced by the experiment, the handle is carefully wrapped up in some kind of cloth.

The apparatus is prepared for use by removing the screw E, and placing 1¾ lbs. of bicarbonate of soda in the generator, A, to which 24 fluid ounces of water are to be added. After making these into a thin paste by stirring, nine fluid ounces of common sulphuric acid are to be poured into the copper cup, N, and that is to be let down by a crook of wire into the generator. After the screw, E, has been firmly applied, and the stop-cock, J, closed, the contents of the generator are to be brought into admixture by moving it round to a horizontal position on the swivel, D, which is supported by the

* The cement used was made of shell lac 3 or 4 parts, white or crude turpentine 1 part, melted at as low a temperature as possible so as not to make bubbles in the mixture. This cement is very strong, but liable, without great care in the regulation of the heat, to have capillary tubes in it from the vaporization of the turpentine. This defect may be completely corrected by cutting away, when cold, the external mass of cement, and putting on a little common cap cement which melts at a much lower temperature and closes the tubes.

wooden frame, B, B. There is a check bar at C. This motion is to be repeated several times. In about 10 minutes the whole of the carbonic acid is liberated, and exists in A, chiefly in a liquid state.

The next step in the process is to attach by means of the stirrup and screw, K, K, the receiver, F, *previously cooled by ice.* The keys, I and J, may then be opened slowly, and instantly the liquid carbonic acid is perceptible in the gauge, L. At the end of 10 minutes the communication with the generator may be cut off—when about eight fluid ounces of liquid acid at 32° F. will be found in the receiver.

By letting this liquid into the box, O, through the pipe, G, a large part of it is instantly expanded into gas, which escapes through the tube, P. The coldness consequent on the enormous expansion freezes another part of the liquid, which falls to the bottom of O. About one drachm of solid matter is thus formed for each ounce of liquid.

The porosity and volatile character of the solid renders its specific gravity of difficult ascertainment. When recently formed it is about the weight of carbonate of magnesia, and when strongly compressed by the fingers, its density is nearly doubled. Solid carbonic acid is of a perfect whiteness, and of a soft and spongy texture, very like slightly moistened and aggregated snow. It evaporates rapidly, becoming thereby colder and colder, but the coldness produced seems to steadily lessen the evaporation, so that the mass may be kept for some time. A quantity weighing 346 grains lost from 3 to 4 grains per minute at first, but did not entirely disappear for 3 hours and a half. The natural temperature was 76°—79°. The solid is most easily kept when compressed and rolled up in cotton or wool. Its temperature when newly formed is not exactly ascertainable because it is immediately lowered by evaporation. Thillorier seems to have entertained the opinion that the greatest degree of cold was created at the time of the formation of the solid. In my experiments a constant decrease of temperature was observed; which was accelerated by a current of air, or any other means of augmenting evaporation. At its formation, the carbonic snow depresses the thermometer to about —85°. If it be confined in wool or raw cotton, its cooling influence is retarded; if it be exposed to the air, especially when in motion, the thermometer descends much more rapidly; and under the receiver of an air pump, the effect is at its maximum. The greatest cold produced by the solid carbonic acid in the air was —109°, under an exhausted receiver —136°, the natural temperature being at +86°.

The admixture of sulphuric ether so as to produce the appearance of wet snow, increased the coldness, for the temperature then fell, under exhaustion, to —146°,* a degree of cold which we were not able to exceed by means of any variation of the experiment. That result is most easily obtained by putting about two fluid drachms of ether into the iron receiver before charging it. A compound liquid may be thus formed which yields a snow in less quantity, but of a more facile refrigeration. Alcohol may replace ether in either mode, but with less decided effect. In the air the alcoholic mixture fell to —106° and remained stationary. By blowing the breath on it, it fell to —110. Left to itself it rose slowly to —106°; but on being placed under an exhausted receiver fell to —134°.

Every attempt to wet the carbonic solid with water, failed, so that no estimate of its relative effects could be made.

The experiments resulting from the great coldness of the new solid, were

* As —146+32 = 178, the cold is nearly as far below the ice-point as 212 —32= 180 is above it.

very striking. Mercury placed in a cavity in it, and covered up with the same substance, was frozen in a few seconds. But the solidification of the mercury was almost instantly produced by pouring it into a paste made by the addition of a little ether. Frozen mercury is like lead, soft and easily cut. It is ductile, malleable, and insonorous. Just as it is about to melt, it becomes brittle or 'short' and breaks under the point of a knife. These facts may account for the discrepancies of authors on this subject. Frozen mercury sinks readily in liquid mercury.

At about —110° liquid *sulphurous acid* is frozen, and the ice sinks in its own liquid, and at —130° *alcohol* of .798, assumes a viscid and oily appearance, which by increase of cold, is augmented until at —146° *it is like melted wax*. Alcohol of 820 froze readily.

At —146° *sulphuric ether* is not in the slightest degree altered.

When a piece of solid carbonic acid is pressed against a living animal surface, it drives off the circulating fluids and produces a ghastly white spot. If held for 15 seconds it raises a blister, and if the application be continued for 2 minutes a deep white depression with an elevated margin is perceived; the part is killed, and a slough is in time the consequence. I have thus produced both blisters and sloughs, by means nearly as prompt as fire, but much less alarming to my patients.

The specific gravity of liquid carbonic acid may be estimated either by weighing a given measure of it in a tube, and deducting the weight of the tube, and of the superincumbent gas, or by means of very minute bulbs of glass as suggested by Sir M. Faraday. By the latter means I obtained the following results, which are compared with those of Thillorier.

		Thillorier.	
Temp. Fahr.	Sp. Gr.	Temp. Fahr.	Sp. Gr.
32°	.93	32°	.83
43°.5	.8825		
51°	.853		
74°	.7385		
86°		86°	.60

The specific gravity particularly at 32°, was examined repeatedly, and with different bulbs, and always found to be at, or very near, to .93. The difference never amounted to .005. The sp. gr. as given by Thillorier at 32° is 83. The anomalous expansion of the liquid as indicated by both sets of experiments is truly surprising. By mine 73.85 parts raised from 32° to 74°, or 42°, become 93 parts, and gain 19.15 parts, while the same bulk of the gases acquires in the same range of temperature only 6.46 parts, or the liquid is expanded very nearly three times as much as its own or any other gas. According to Thillorier, 60 parts gain 23 parts by an elevation of 54°, while the same bulk of air would under like circumstances be augmented only by 6.75 parts; or the liquid is nearly four times as expansive as the gases.

As below 32°, or at reduced pressures, the augmentation of temperature is productive of much less expansive influence, we may infer that under the weight of a few atmospheres, as when near to its freezing point, liquid carbonic acid is scarcely more dilatable by heat than water. Between —4° and +32°, its expansion is 0.053 while that of air is 0.069. These facts suggest the inquiry how far water at *very high temperature and pressure* may be obedient to the same expansive influence, and thus by suddenly filling the whole interior of a boiler, sometimes cause explosions.

The pressure of carbonic acid gas, when placed over its liquid, is given

by Thillorier at 32° and 86°, as 36 and 73 atmospheres respectively. By means of the gauge S, M, R,—I found the pressure as follows:

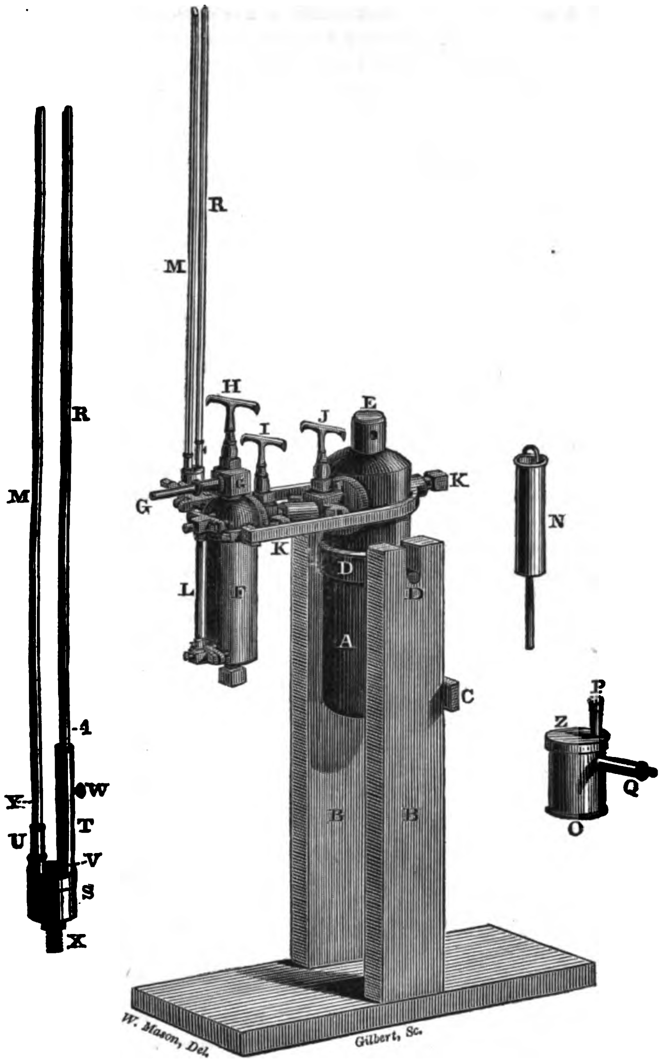
32°	36 atmospheres.
45°	45 do.
66°	60 do.
86°	72 do.

The principle of the gauge renders it capable of registering the pressure with great accuracy:—for as one tube, M, begins to mark the pressure from the commencement of an experiment, and the mercury in the other, R, does not reach a visible point until the first has shewn a pressure of several atmospheres, the second tube is equivalent in effect to one of several times its length. The first determines the amount of pressure, at which the mercury reaches the initial point on the 2nd, and the 2nd, subsequently, exhibits the multiplicators of that initial quantity. Thus, if when the mercury is at five atmospheres in M, it is at the unit mark in R, the value of that unit will be five, and the numbers representative of the pressure on R, must be multiplied by five; or R is equal in effect to a tube of five times its length. By these means very short tubes may be used to determine very high pressures. Inequalities in temperature, irregularities in the cement, and other causes, may vary the capacity of the socket T, W, but as M always signifies the unit for R, in each case, no error can arise from these causes. There must, of course, be a correction for the weight of the mercurial column in R, which is to be added to the product. Care must be taken to keep the temperature of the vessel which holds the liquid below that of the gauge and tubes, otherwise the liquid will be formed by condensation in the latter. This actually happened in the attempt to ascertain the pressure at 86°, when the natural temperature was 75°. Bubbles of gas were seen ascending through a liquid in M, up to its surface at a few inches below the mercurial cylinder. This as far as relates to the tubes may be avoided by prolonging the socket of M, down into the mercury of the cup, so as to include a cylinder of common air between two cylinders of mercury, and prevent any carbonic gas from entering either the socket, or the glass tube. A correction for the weight of this column, must in such case be made.

When a glass tube, hermetically sealed at one end, and cemented into a brass socket and screw at the other, is attached to a charged receiver and cooled by snow or pounded ice, liquid carbonic acid may be collected in it. It is perfectly colourless and transparent, and the specific gravity bulbs, previously introduced, are seen to ascend or descend, as the temperature is altered. When the tube so charged is opened, the liquid becomes violently agitated, escapes rapidly, grows colder and colder, and finally the remainder is converted into a solid, more dense than the snow already described, but nearly white, and very porous. If the tube be exposed to a paste of carbonic snow and ether, the liquid is solidified into a mass which is not porous but which sinks in the liquid as the latter is formed again by the melting of the solid.

The analogy between liquid carbonic acid and water, is thus completed for we have liquid, vapour, snow, and ice, exhibited by both.

By the previous introduction of water, ether, alcohol, metals, oxides, or oils, &c. into such tubes, and then filling them with liquid carbonic acid, the resulting phenomena may be easily observed. Water being heavier rests below the new liquid, and does not appear to mingle with it even at the surface of contact, for when the latter is let off, no bubbles appear in the water, and it is frozen at the top into a solid ice.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W. Mason, Del.
Gilbert, Sc.

When alcohol or ether is introduced, the new liquid falls through it in streams, as water would do, but soon renders it milky by mixture. The removal of the pressure causes a violent effervescence, and immediately the clear, colourless ether, or alcohol, is seen alone in the tube; no solid being formed. When alcohol holds shell-lac in solution, the acid causes its precipitation in light whitish flocculi, which are immediately re-dissolved when the acid is suffered to fly off. Nothing remains but the brown lac-stained liquid.

Liquid carbonic acid did not appear to act on any of the metals or oxides, but the experiments on this point demand a further examination. Its inaction is probably owing to the want of the force of 'presence,' or of 'disposing affinity.'

When the liquid has been frozen in a tube of glass, the tube may be melted off by the blow pipe, and hermetically sealed. Such a tube will always retain the liquid, or gas, the former, if in sufficient quantity, at all temperatures, if not, the latter alone will be found in it at high temperatures. I have one such tube, which begins to shew moisture at 56°, and exhibits a constantly elongating cylinder of liquid, as the coldness is increased. At 32° the cylinder is about half an inch in length.

Carbonic acid mechanically powerful as it is, is not applicable, perhaps, either to locomotion or projection; but though the reasons for this are most of them obvious, the Franklin Institute has appointed a committee to investigate and report on the subject, that the exact truth may be known, and the waste of time and talent likely otherwise to be experienced, be saved to the country.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Cubes and Squares.

In reading the account, in the Journal for August, of Mr. Turner's theorem for finding the cubes by the addition of the groups of *odd* numbers, I was led to the consideration of cubes and squares, and made the following discoveries: at least they are discoveries to myself, as I know not that they have before been adverted to.

I. *For the Cube.*

Take the series of *even* numbers and divide them into groups of two, three, &c., terms consecutively, and put the figure denoting the number in each group at the top. The sum of each group, with the addition of the number denoting the group, (or, what is the same, the addition of the number of the figures in the group,) makes the *cube* of that number. As,

$$\overset{2}{2\ \ 4} \mid \overset{3}{6\ \ 8\ \ 10} \mid \overset{4}{12\ \ 14\ \ 16\ \ 18} \mid \overset{5}{20\ \ 22\ \ 24\ \ 26\ \ 28}$$

The cube of 2 is $2+4+2 = 8$.
The cube of 3 is $6+8+10+3 = 27$.
The cube of 4 is $12+14+16+18+4 = 64$.
The cube of 5 is $20+22+24+26+28+5 = 125$.

II. *For the Square.*

Divide the natural numbers into groups,—not of one, two, three figures,

&c,—but of *even* consecutive numbers, groups of 2, 4, 6, 8, &c., and number the groups 1, 2, 3, 4, 5, &c. In the first group the first figure is the square of 1; in the second group the second figure is the square of 2; in the third group the third figure is the square of 3, &c.: As,

$$\overset{1}{1}\ 2 \mid 3\ \overset{2}{4}\ 5\ 6 \mid 7\ 8\ \overset{3}{9}\ 10\ 11\ 12 \mid 13\ 14\ 15\ \overset{4}{16}\ 17\ 18\ 19\ 20$$

Or the squares may be found without groups, by the constant addition of 2, as follows. The square of 2, which is 4, is the *third* figure from 1, the first square: the distance of every subsequent square increases by 2: that is, the square of 3 is the *fifth* figure from 4, the square of 2; the square of 4 is the *seventh* figure from 9, the square of 3; the square of 5 is the *ninth* figure from 16 the square of 4, &c. Thus,

$$\overset{1}{1}\ 2\ 3\ \overset{2}{4}\ 5\ 6\ 7\ 8\ \overset{3}{9}\ 10\ 11\ 12\ 13\ 14\ 15\ \overset{4}{16}\ 17\ 18\ 19\ 20\ 21\ 22\ 23\ 24\ \overset{5}{25}$$

Having a series of natural numbers, the roots 1, 2, 3, &c., may thus be put over their squares. It may be seen, that the distance from 4 to 9 is 5 figures; from 9 to 16 is 7 figures; from 17 to 25 is 9 figures; and so on, increasing by 2.

Or the squares may be found as follows: Divide 1 from the other numbers; then for *even* roots take as many of the next even numbers as are equal to the root; and for *odd* roots take as many odd numbers as are equal to the root: the last figure of each group gives the square of the number of the group. As,

$$\overset{1}{1} \mid 2\ \overset{2}{4} \mid 5\ 7\ \overset{3}{9} \mid 10\ 12\ 14\ \overset{4}{16} \mid 17\ 19\ 21\ 23\ \overset{5}{25} \mid 26\ 28\ 30\ 32\ 34\ \overset{6}{36}$$

It is seen, that there is an alternation of groups of even and odd numbers. The omitted figures are less in number by one, than the number of each group.

The square of any number being known, the square of the next number *above* is ascertained by adding to the known square the sum of the two numbers. As, the square of 40 being 1600, the square of 41 is $= 1600 + 40 + 41 = 1681$.

Of course the square of the next number *below* the number, whose square is known, is ascertained by deducting the sum of the two numbers from the square: 1681 being known as the square of 41, subtract $41 + 40$ from 1681, and it gives the square of $40 = 1600$. W. A.

Mechanics' Register.

List of American Patents which issued in January, 1838.

With Remarks and Exemplications by the Editor.

1. For improvement in the *Loom for weaving knotted Counterpanes*, and other fabrics in which the woof is raised from the surface; Erastus B. Bigelow, West Boylston, Worcester county, Massachusetts, January 6.

The claims made are, "1st. Raising the knots which compose the figure, from the surface of the cloth, by a series of movable dents, or teeth, or

hooks. 2d. Supporting the woof during the operation of the movable dents, or teeth, or hooks; and thereby regulating the length of the knots by a bar, beam, or race piece, as described. 3d. Separating, or dividing asunder, the threads of the warp, by means of beveled pieces of metal on the sides of the movable dents, or hooks, or teeth, to prevent them catching into and breaking the threads. 4th. A toothed cylinder, or cylinders, acting on machinery intervening between them and the dents, or teeth, or hooks, successively to raise the knots which compose the figure. 5th. The application of a prism and pattern card to produce the variations in the pattern, or figure."

Accompanying the specification of this patent are five sheets of drawings, affording a clear view of the invention, of which no adequate idea can be furnished without such aid.

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2. For a machine for *Crimping Leather for Boots;* Lucius Upham, Putney, Windham county, Vermont, January 9.

A common boot crimp is taken, and the back edge of it is cut away at the heel, and contiguous to it at the leg and foot, so as to admit three double blocks of about three inches long to occupy the place of the removed stuff; the pairs of blocks lay side by side, and are coupled together by wire staples, forming loops at their backs, each pair having two staples. Through each block passes a screw which is to bear on the back edge of the crimp, and when the leather is tacked on, it is to be strained by turning the screws. The claim is to "the application of the six blocks connected by staples, and moved by screws, in the manner before described; to move independently of each other, or simultaneously, as the leather may require."

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3. For a machine for *Moulding, and off-bearing, Brick and Tile;* Loomis E. Ransom, Millport, Chemung county, New York, January 9.

The prepared clay is put into a hopper, or box, from whence it is forced into the moulds placed in front of the hopper, which is open for that purpose. The hopper, and the frame of this machine are so formed that the moulds when being filled, slope back at an angle of from five to ten degrees, giving them a tendency to fall towards the table in front, and preventing the clay from falling out. There are ribs in front of the hopper, so formed and placed as to divide the clay and conduct it into the moulds. The follower which fills the moulds works horizontally from the back of the machine, it rests on the bottom of the hopper, and slides in grooves, being operated on by a treadle. When the moulds are filled, strikers, formed of plates of metal, are brought down; there is one of these strikers to each brick, and it is guided by a rebate, or groove on the ribs. The lower ends of the strikers are sharp, and curved crosswise. The claims are:

"1st. The manner of conducting the ribs of the grating, and of arranging them as described.

"2d. The method of constructing the strikers as above described, with the lower ends curved forward, to prevent the clay adhering to the face of the strikers.

"3d. The arrangement of the inclined frame to give the moulds an inclining position forward, in order to cause the clay, by its gravity, to fall into the moulds after being cut, and to enable the operator to remove them with ease as above described."

4. For *Strengthening the axles of Rail Road Cars and Locomotives;* Ziba Durkee, Philadelphia, Pennsylvania, January 9.

Upon the middle of each axle there is placed an iron cylinder, having flanches rising from each of its ends, giving to it the general form of a common bobbin. These flanches are each to have holes through them to receive the ends of rods of iron, the other ends of which pass through iron plates placed on the face of each wheel, and surrounding the hubs; there may be four, or any preferred number, of such rods, which are to be drawn tight by nuts and screws. This, the patentee says, will "greatly strengthen the axle, and prevent it from breaking, and support the wheels should an axle break. With this attachment a smaller axle than those now in use will answer every purpose." The claim is to the above "mode of strengthening the wheels and axles of locomotives and rail road cars, by the combination of the cylinder, plates, and rods, constructed and connected substantially as within described."

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5. For an improvement in the *Machine for breaking Flax and Hemp;* Andrew Forsyth, Columbia, Maury county, Tennessee, January 9.

This machine is constructed like the common hand break, but the slats forming the bed, are placed upon springs, that they may yield in some degree to the stroke. This constitutes the whole of the so called improvement, and is, of course, the only thing claimed.

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6. For an improvement in the mode of *Attaching Springs to Carriages;* David A. Morton, Groton, Tompkins county, New York, January 9.

To the underside of the bottom of a carriage, are to be fixed cases, or tubes, running lengthwise, and near to each side. Within these cases there are to be spiral springs, wound so as to leave a space between each coil, to allow of their being drawn together. Rods passing through these springs have straps attached to them, which straps extend out at either end and wind round a cylinder fixed upon a shaft for that purpose. To the jacks by which the body is to be suspended are also attached straps which in like manner wind around cylinders upon the same shaft with the straps first named, but in a reverse direction. The straps which are attached to the springs pass over rollers at the ends of the spring case, to conduct them to the cylinders upon the shaft. Different modes of modifying these springs, straps, cylinders, and their appendages, are pointed out by the patentee; there may, for example, be but one spring case along the centre of the carriage body, or the spiral springs may be affixed without their being enclosed in a case.

The patentee says "it will appear obvious that when the body is thus suspended and the carriage is in operation, a portion of all the straps are alternately unrolling and rolling up on the cylinders. When the body settles, a portion of the straps attached to the springs are at the same time taken up, which will consequently contract the springs. When the body rises a portion of the straps attached to the jacks are taken up, and a portion of those attached to the springs are at the same time thrown off, which will necessarily elongate the springs."

"What I claim as my invention and desire to secure by letters patent, is the combination of the above described rollers, the straps, and the irons by

which the springs are contracted, with horizontal spiral springs attached to the under side of the carriage body as herein described."

There is certainly much ingenuity in the above described arrangement, and, so far as we know, it is essentially new; and we think also that these springs will operate pleasantly; the great objection to them is their liability to fracture, an accident of frequent occurrence in spiral springs similarly acted upon.

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7. For a machine for *sowing Plaster, Ashes, and other separable substances;* Julius Natch, Great Bend, Susquehanna county, Pennsylvania; first patented August 17th, 1835. Surrendered and re-issued January 9.

This machine was noticed at p. 204, vol. XVII, but with a mistake in the name, the patentee being called Notch, instead of Natch; we there remarked upon the defectiveness of the specification, a fault which the new one is intended to cure. The following are the claims now made:

"The invention claimed by me the said Julius Natch, and which I desire to secure by letters patent, consists in the combination of the slide or agitator and hopper, as described, for agitating the substance in the same to be sown, so as to cause it to pass from the hopper regularly and evenly. I likewise claim the gauges for regulating the swinging parts of the hopper, whether constructed as herein set forth, or in any other manner substantially the same in principle."

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8. For an improved *Machine for cutting Straw, and other substances;* Edwin Gillett, Ellington, Tolland county, Connecticut, Jan. 9.

In the general construction of this cutting machine there is not any thing new. The straw to be cut is placed in a trough, and is fed to the knife by a comb-like plate, denominated vibrating fingers. The knife is attached to a vibrating frame worked up and down by a crank, in the ordinary way. The things claimed are a "spring rest in front of the knife, in combination as described; and the method of feeding the vibrating fingers."

The spring rest consists of a bar of iron, or of steel, in front of the cutting box, and between which and the fore end of the box the knife is to pass; said spring rest having a yielding motion, for the purpose, it is said, of preventing the clogging of the machine. We have seen many similar machines work, but we never witnessed the necessity for such a contrivance, nor are we very certain that the proposed effects would be produced by it. A rod extending from the crank to the feeding comb, or vibrating fingers, is designed to give the required movements to that article.

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9. For improvements in the mode of *Constructing and operating Churns, &c.;* S. P. W. Douglass, Lansingburgh, Rensellaer county, New York, January 9.

This patent is taken for a peculiar mode of giving to the dasher of the common vertical churn a rotary, as well as the ordinary vibrating motion, and the mode described of doing this forms the subject of the claim.

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10. For an improvement in the *Machine for planing plank, boards, and clap-boards;* Barnabas Langdon, Troy, Ransellaer county, New York, January 9.

"The nature of my improvement consists in providing machinery, that in

its operation will produce an horizontal reverberatory movement by which the plank, or board, is driven in a lengthwise direction before a stationary plane stock set with cutters, so as to plane and smooth the plank, reducing it at the same time to the required uniform thickness; and also by providing an additional apparatus for the purpose of grooving, tongueing, and straightening its edges, all at one operation."

The claims made are to certain "grooves, or channels, in the faces of the plane stocks, with the arrangement of the cutters corresponding with the grooves, whereby the extra thickness of the plank is taken off, or reduced, with greater ease and effect. The particular arrangement and construction of the plates, or slides, to which the cutters are fastened. The clamps with the back plates for guiding the planks, or boards, and keeping them in a straight direction. The iron slides with their springs for supporting the plank in the operation of planing," &c.

The foregoing claim relates to certain particulars in the construction, which are represented in the drawing. The machine itself is of double the length of the stuff to be planed, so that for boards of eighteen feet in length, the bench would be upwards of thirty-six feet. Under the bench there is a rack, driven backward and forward by a pinion, with a reversing motion. The plank stands edgewise, between two cheeks, and from the upper side of the rack rise two drivers, which are to bear against the back end of the plank and force it forward. At each end of the bench there are sets of irons, or cutters, placed one behind the other, to cut the stuff in succession; these cutters operate like ordinary plane irons, and stand vertically. The devices for planing clapboards, &c. we shall not attempt to explain. To the machine, in its general construction, there is not any claim; we think, however, that it possesses sufficient novelty to have justified one, without limiting the claims to its individual appendages.

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11. For improvements in the *Machine for shaving Shingles;* Barnabas Langdon, Troy, New York, January 9.

The claim is to "the slide with its seat or checks, for holding the shingle and giving it its proper taper; the manner of securing it in its bed by means of the clamps, and carrying it before the face of the plane, and also the general combination of the different parts," &c. These claims refer to the peculiarities of construction devised by the patentee; but the machine does not otherwise differ materially from such as have been previously made.

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12. For an improvement on the *Planing Machine,* for which a patent was obtained August 28th, 1833; James McGregor, Wilton, Saratoga county, New York, January 9.

The original machine is noticed at p. 120, vol. XIII; the improvements now added have undoubtedly much enhanced its value. A good general idea of them may be obtained from the following claims:

"The first improvement which I claim consists in the new arrangement of the tongueing saws, namely, in the first jointing of one edge by a circular saw upon the first saw shaft, and the subsequent jointing of the opposite edge, whilst the edge first jointed is at the same time effected, at a point opposite, or nearly opposite to the second jointing saw. My second claim to improvement is to the employment of the gauge strip, in the manner and for the purpose set forth." There are some other claims, but from the nature of the machine a drawing would be required to make them understood.

13. For improvements in *Locomotives and Rail Road Cars;* Jonas P. Fairlamb and L. C. Judson, city of Philadelphia, January 9.

Claim.—"What we claim as our invention and desire to secure by letters patent is the construction and application of the *cylinder bunts*, to graduate the concussion of two bodies coming in contact. The construction and application of the *safety guard clamps* to wheels, to avoid danger when an axle breaks. The application of *small truck wheels* to guard against danger when a large wheel breaks. The *spring lever*, and mode and manner of guiding cars from one track of railway to another without the use of switches; and the construction and application of the *double universal joint*, each part as specified and described."

What the patentees call cylinder bunts is a new form of buffing apparatus, to ease off the blow when two cars, &c., come into collision. It is proposed to have strong metallic cylinders bored out in the manner of cannon, and into these to fit pistons, with rods projecting out, and covered with some elastic material, to receive the blow; within the cylinders are to be placed spiral springs; but the principal dependance is upon the elasticity of the air, re-acting upon the piston. "It is believed that with four such cylinders of twelve inch calibre, eight feet in length, two inches thick, of sound cast iron, well hooped with first rate wrought iron upon each, two locomotives may meet when going at the rate of thirty miles an hour without sustaining any damage." *Credat Judaeus.*

The safety guard clamps are to extend over each wheel, and come nearly in contact with the hub on each side, so that in case of the breaking of an axle, they shall form bearings by being brought into actual contact.

The spring-lever, which is to be a substitute for switches, is to be attached to the frame of each set of wheels of an eight wheel car in such a manner as that by pressing upon them they shall direct the cars; how this is to be effected is by no means clearly made known.

The double universal joint is to connect cars together, and to be used in lieu of the devices now employed.

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14. For *apparatus for leaching Ashes*; Elijah Williams, Westfield, Chautauque county, New York, January 9.

This patent is taken for a particular mode of constructing the apparatus for leaching ashes; the claims made being to "the use of a boiler like that described, furnished with a safety tube, for the purposes set forth."

The ashes are to be boiled, and afterwards strained, in the apparatus described, the superiority of which over the means in ordinary use is not very apparent; the organ of novelty is very small, that of utility we have not been able to discover.

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15. For an improved *Canal Boat;* Edward Randolph, Salt Creek, Muskingum county, Ohio, January 9.

This is a contrivance which differs but little from some that have preceded it, but still sufficiently to obtain the grant of a patent. The boat is to be of the twin kind, with a paddle wheel in the centre. The principal dependence for its utility is upon its leaving the waters unagitated by the aid of a fender board, and a smoothing board, which are thus claimed. "What I claim as my invention, and desire to secure by letters patent, is the way

the wheel is hung in a square trunk formed by the fender board under the wheel; and also the smoothing board hung behind the wheel, so as to discharge the water without doing any injury to the banks of the canal."

Methods very similar have been before essayed, but the great difficulty in attaining this long sought end has not been removed, and from the obstinacy of its character is likely always to remain in full force. Canal boats will displace a portion of water equal in weight to themselves, and to that of their load, and this must be constantly flowing back as the boat advances in order that the cavity may be filled, which must otherwise be left at her stern This is in conformity to a law of nature which has existed throughout all time, and one which nature alone can repeal.

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16. For an *Apparatus for Steaming, Boiling, &c.;* B. F. Gold, city of New York, January 9.

This contrivance is merely a double cover of tin, enclosing air between the two laminæ, and to be placed like a dish cover, over articles to be boiled, &c. The claim is to this contrivance.

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17. For improvements in *Scales, Beams and Weights;* Alvah N. Free, city of Troy, New York, January 9.

The claim made is to "the making the upper edge of the scale beam on which the poise, or weight, hangs, smooth and even, and combining therewith a poise having a pointer, or pointers, as described." The beam is divided on the side in the usual manner of steelyards, and a pointer rising from the top of the poise indicates the weight of the article weighed, by the divisions and the respective figures marked on the beam.

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18. For a *Machine for washing and pulverizing potatoes in the manufacture of Starch;* Sylvanus Richardson, Jerico, Chittenden county, Vermont, January 9.

This is an apparatus in which a revolving shaft, furnished with arms set obliquely, operates upon the potatoes within a circular trough kept filled with flowing water; they are conducted into a hopper, by the action of the apparatus, and from the hopper pass under a grating cylinder; they then drop between rolling cylinders, by which they are reduced to a complete pulp, and are thus prepared for the making of starch from them. The individual parts of the apparatus are not claimed, but the inventor says that he is "not aware that the trough for washing, with its appendages, and the graters and rollers in their present arrangement, and for the uses and purposes set forth, have ever been before so used. He therefore claims as his invention the washing trough and its appendages in combination with the grater and rollers, in their arrangement and combination as described, for the uses and purposes herein before described."

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19. For an improvement in his *Patent Lamp, and in other analogous Lamps;* Samuel Rust, city of New York, January 9.

This improvement consists in the manner in which a shade is added to the lamps previously patented by Mr. Rust; the roller for raising the wick; its connexion with the stopple and tube being the same as formerly.

20. For applying a shade to the *Lamps* formerly patented; Samuel Rust, city of New York, January 9.

This patent, as will be seen by the title, is for a purpose similar to the former, the mode of fixing and arranging being sufficiently different, however, to induce the taking of a separate patent.

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21. For a *Cooking Stove;* E. L. Parshley and B. Furbish, Brunswick, Cumberland county, Maine, January 9.

The difference between this and several other stoves, is very slight. The claim is to "the particular mode of arranging the plates for conducting the draught down behind the fire, under, and up at the back of, and then over, the oven, to the front thereof, and thence back under the boiler, or boilers, to the escape flue at the back of the stove." The apparent novelty is the insertion of a plate between the top plate of the oven and the top plate of the stove, reaching entirely back to the back plate, so as to bring the draft to the front from the back, and carry it thence back to the smoke pipe at the rear end of the stove.

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22. For improvements in the *Machine for rubbing and hulling Rice and other grain;* Alfred and William J. Duvall, city of Baltimore, January 9.

A hollow cylinder is to be made of cast-iron, which is to be formed of staves, and hooped together. Within this is to be placed a cylinder which is to revolve within it, having a space of two or three inches between the two. The outer cylinder, which is to be stationary, has teeth, or short arms, projecting inward, and the inner cylinder has corresponding teeth projecting outwards, which pass between the former. The grain is admitted through openings in the head of the machine, and discharged at its lower end. The claim is to "the mode of constructing the cylinder and runner with teeth passing between each other in the manner described." Machines for the same purpose, and consisting of one vertical cylinder revolving within another, and armed with teeth, have been long in use; the teeth, however, have been generally such as to operate like graters, whilst those used in the present machine act as stirrers and agitators; our impression is that if all the models formerly existing in the office were still there, some having a near approach to this would be found.

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23. For a *Spherometer for ascertaining the relative Bearing of Places;* Cephas Johnson, Southington, Hartford county, Connecticut, January 9.

The claims made are to the manner of combining together the several graduated plates, and arcs of circles adopted by the patentee. "namely, the compass, divided into two separate parts, set vertically on the opposite side of a circle, having the eastern points on one part, and the western points on the other part; the part on which the western points are marked standing on the eastern side, and that on which the eastern points are marked standing on the western side of the instruments. The prime vertical in the form of a semicircle attached to the compass plates, turning on its ends to correspond with said plates, beviled on the inner edge, graduated for measuring geographical miles, and having shoulders projecting to indicate the point of the compass. The movable meridian in the form of a semicircle,

beviled on both edges, intersecting at once the prime vertical and equinoctial circle, and turning on pivots at the ends; the sliding meridian moving horizontally around a circular plate; the equinoctial circle set vertically, beviled on its circular edge, and graduated on both bevils, commencing at opposite ends on each bevil; the junction of the equinoctial circle at its base with a circular plate; all combined and made to move in the manner set forth; to produce, and, by such combination and movements of the movable parts, producing the effect of ascertaining the relative bearings of places, directing a ship by the shortest course from one place to another, running lines, and determining true distances."

After this imposing array of claims it will not be expected that we shall undertake to describe, and discuss, the merits of an instrument consisting of so many parts. We are apprehensive that this, like many similar instruments, will serve better to display the skill of the contriver, than to fill his pockets by coming into extensive use.

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24. For an improvement in *Carriage Springs;* William Patton, Towanda, Bedford county, Pennsylvania, January 9.

There have been several patents issed within a few months for various modes of constructing springs for carriages; most of them are contrivances of little or no value; in many instances they bear so close a resemblance to each other as to show that they are the results of imitation; a fact which would be still more strikingly exemplified were we to publish the applications for similar patents which have been rejected. Where patents have been granted, the things claimed have, of course, been supposed to possess some novelty, whatever doubt may have existed respecting their utility.

The claim in the patent before us, is to "the adding to, and combining with, the semi-eliptical, or cradle spring, straight bars, cross beams, double bows, or projecting standards, one or more flat spiral springs, constructed as described." The spiral springs are placed, and operate, between the upper and lower springs, in a manner differing but little from those patented by William Croasdale, the specification of which will be found at p. 235, vol. xx.

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25. For improvements in the *Machine for Mortising and Dovetailing;* John Brainard, Aurora, Portage county, Ohio, January 9.

In this machine the mortising chisel is worked up and down by a toggle joint, to one of the bars of which a handle is affixed, which projects out like a pump handle; the stuff is placed on a bed, and otherwise managed in the ordinary way. As respects dovetailing, there is little probability of the machine ever being used for this purpose, as there is no particular provision adapting it to this object, the stuff to be dovetailed being placed upon the bed, and moved by hand so as for the chisel to cut as it does in mortising. The claim is to "the combination of the toggle joint, handle, and chisel stock, applied to mortising and dovetailing, as described."

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26. For an improvement in the mode of *Hanging Doors, to prevent rain from being forced under them by Wind, &c.;* Edmund C. Tilson, Thomaston, Lincoln county, Maine, January 9.

The claim is to the "letting a door down an offset in the threshold when

shut, to prevent the rain from driving under the door into the building; and the method of raising the door so as to swing over the stool, and of sustaining it at pleasure when closed, as described."

The inventor says, "my invention consists in making a perpendicular offset in the doorstool, or threshold, of about half an inch below the level of the highest part of the stool, so that the door when closed may be let down, or if not obstructed will slip down of itself, the depth of the offset, leaving the top ridge of the stool elevated thus much above the bottom of the door on the inside, but not on the outside; and in placing over the door, within or behind the inside casing, a lever moving on a pivot, midway from the short end of which a rod is let down connected by a spur with the heel of the door, so as to raise it when a power is applied to the other end of the lever, which is done by letting down a rod from that end also, with a small chain at the lower end to wind it on the windlass in the wall by a knob or crank on the outside of the casing. And also in making an offsett in the eye, or joint of the door hinge, so that one leaf of the hinge may slide down on the connecting wire, half an inch below the other when the door is shut; and placing a slide in the jamb casing at the heel of the door, to slide under the door to keep it up to its swinging level in fair weather, or when there is no occasion for letting it down."

Both ingenuity and skill are displayed in the contrivance alluded to, but there are others which have been devised, consisting of fewer parts, which have nevertheless been abandoned on account of their complexity and liability to derangement.

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27. For improvements in the *Machine for Boring Framing Timber;* Jared Badger, Brooklyn, Windham county, Connecticut, January 20.

This machine is constructed so that its frame may be moved along, and affixed to the timber to be bored, preparatory to its being mortised. By turning a winch, two vertical shafts geared into each other, and carrying augers at their lower ends, are made to revolve. Such a machine may be modified in so many ways as to render it difficult, if not impossible, to construct one which will secure any available right to its inventor, as the claim must necessarily be confined to special contrivances, which admit of the substitution of others equally efficient. In the present case the claims are confined to "the mode of regulating the auger, or augers, crosswise of the timber, by means of slides at the top and bottom of the box, or carriage, as described.

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28. For a *Machine for Sowing or Planting Ruta Baga, and other seeds or grain;* Hiram R. Merchant, Guilford, Chenango county, New York, January 20.

This resembles many other planting machines, as, indeed must necessarily be the case where contrivances for the purpose have been so numerous. It has two handles, and a single wheel, which rolls on the ground like that of a wheelbarrow. The hopper which is to contain the seed, is placed in advance of the wheel, and has in front of it a share for making a furrow into which the seed is to be dropped, and behind it two scrapers to close the ground over the seed, after which follows the wheel, or roller. The claim is to the mode of "construction, in placing the hopper forward of the

wheel, causing the wheel to answer the double purpose of wheel and roller; also, the manner of moving the slide, and scraping the dirt from the wheel."

29. For improvements in the art of *Measuring and Cutting Garments;* William and Charles Kahlen, Bloomsburg, Columbia county, Pennsylvania, January 20.

The specification of this patent is a little MS. volume of diagrams and description, consisting of about twenty pages. We have so frequently confessed our lack of learning in the mathematics of tailoring, as to render unnecessary any excuse for not, on the present occasion, offering a review of the treatise before us. The authors have not furnished any summary of its contents in the form of a claim, this being diffused over the whole work, and the system, in its general features, being considered as essentially new.

30. For improvements in the *Common, and Power, Loom;* Benjamin Lapham, Waterford, Saratoga county, New York, January 20.

"The nature of my invention consists in employing a spring to move the *wagstaff* in throwing the shuttle, and of dispensing with the ordinary *picker, picker strings* and *picker rods*, commonly used in the power loom; which I effect by straining a spring gradually during a full revolution of the cam shaft, by which the necessary force to throw the shuttle is acquired by an easy and uniform resistance to the driving power, exerting that force, always certain, under any speed of the loom."

"What I claim as new, and desire to secure by Letters Patent, is the manner of applying the principle of gradually accumulating a deposit of power to throw the shuttle, whether it be by the use of straining a spring or by raising a weight, as herein described. And secondly, the particular device specified, taken and considered as a combination of old methods to produce a new result."

31. For an improvement in the *Furnaces for Stoves* for burning anthracite; Eben Eaton, city of Troy, N. York, January 20.

This stove is to have mica sash on each of its sides, the cast iron plates being as entirely composed of open work as is compatible with its construction. The grate which is to contain the fuel is a kind of basket grate, composed of fine separate pieces, which when properly combined, form a hollow cylinder intended to revolve on an axis, with which it is provided for that purpose; the particular manner of forming this grate is set forth in the specification, and the claim made is to "the furnace constructed, substantially in the form above described, or with such variations only as will not alter its character, or mode of operation.

32. For a machine for *Trashing Grain and Shelling Corn*; Myron T. Gilbert, city of Troy, New York, January 20.

This machine is a combination of the ordinary thrashing machine, with its toothed cylinder and concave, and of that kind of corn shelling machine in

which a revolving plate is used, set with teeth. The shelling plate, or disk, constitutes one end of the thrashing cylinder, and the corn to be shelled is fed in at one side of the machine in the usual way. There is a shelling plate forming a segment of a circle, say one third, which is of cast iron, and has teeth on it like those of the revolving disk, opposite to which it is placed so that the ears fed in shall pass between them. The claim is to "the mode of constructing the thrashing cylinder and shelling wheel, as before described, being cast in one piece. And the combination and arrangement of the thrashing cylinder and concave with the shelling wheel and segment plate in one frame, for thrashing grain and shelling corn at one operation.

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33. For improvements in the *Apparatus for Diving*; William H. Taylor, city of New York, January 20.

This diving dress is in most points like several others in its general aspect and construction; the principal improvement consisting in the employment of a larger portion than usual of metallic cylinders, in combination with the flexible water proof material, the more effectually to protect the limbs and other parts from injury. The claims are "*first*, the peculiar construction of the body piece, with its appurtenances of the pipes and chambers, as described. *Secondly*, the joint of the arms and legs, as made of spiral or circular wires, or hoops, covered with india rubber cloth, or other substance impermeable to water. *Thirdly*, the mode in which water proof covering, constituting part of the joints, is connected and secured to the cylindrical pieces of the arms and legs, by means of flanches upon said pieces, and a seizing of copper wire, or other fastening."

There is a pipe for conveying air down by means of a force pump, and another pipe from which the air respired is discharged. We cannot pretend to run a parallel between this and the numerous other similar apparatus of which we have some knowledge, not having seen a practical trial of the others; but on a late visit to New York, the above described machine was in actual use; the diver remained under water for about three-fourths of an hour, suffering, apparently, but little inconvenience during that time; he moved about with perfect facility, and passed into water of different depths sending up various articles from the bottom. We know that in all this there was not any thing of actual novelty, but it is mentioned because it tested the particular apparatus of which we have been speaking, and so far as the trial went it was perfectly satisfactory.

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34. For an improved *Cooking Stove*; Horace V. Teall, Canajoharie, Montgomery county, New York, January 20.

There is no very characteristic feature in this stove; the claim is to "the construction of a partition enclosing the two large holes for boilers, with the valves, or dampers," which we do not think it worth while to describe.

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35. For improvements in the construction of *Bee Houses and Bee Hives*, and the arrangement thereof; John Searle, Franklin, Merrimack county, New Hampshire, January 20.

The specification of this patent contains a system of management, and

a plan for the construction of the houses of bees, much in detail, and accompanied by various graphic illustrations. The claims made are to the construction of a spout, a balcony and its appendages, a ventilator, a feeder, a double top to the hive, and a cement floor to the house; all of which are fully described, and in a manner evincing a knowledge of the subject. The whole, however, is too intricate for a brief description.

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36. For an improved *Corset Truss for Ruptures;* John Oberhauser, city of Charleston, South Carolina, January 20.

The claims under this patent are to "the construction of a corset truss, under its various modifications as described; which shall sustain the muscles of the abdomen by the action of the steel spring, or springs, which surround the body, as contradistinguished from the support by bandages which have been frequently resorted to, which springs are widened out by stiff plates, capable of receiving and applying two or more pads to the ruptured parts, in the manner set forth."

A general idea of the mode of construction may be formed from the foregoing claims; this system of forming trusses, like most others, will afford advantages in certain cases, but it still presents but little of peculiarity, or of addition to the resources of the surgeon.

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37. For a machine for *Cutting Heading for Casks;* Lee Wells, Hartsville, Onondaga county, New York, January 20.

This is said to be an improvement on George Parke's machine, to which we shall not take time to refer. The heading, it appears, is to be cut by a knife, and the claim is to "the construction of the knife gate, as described," which description is not very luminous.

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38. For an improvement in the *Horizontal Wind Mill;* William L. Thomas, and J. Lewis, city of Boston, January 27.

The claim made in this horizontal wind mill is to "the manner in which the opening and closing of the wings is effected, as described." The wings are represented as in the same shape with those of the ordinary vertical sails; the devices used for turning the sails consist in causing their inner ends to be acted upon by what is called a double inclined plane, the inclination of which causes then alternately to present their edges and sides to the wind. To lessen the friction incident to this mode of turning them by the inclined guide piece, friction rollers are used. At their outer extremities the sails are braced together, so as to give them the requisite stability.

We very much doubt the success of this plan, and apprehend that it will not be found equal to the ordinary mill with vertical sails. The mode of turning the sails will produce considerable and constant friction, in spite of the friction wheels, and will, we apprehend, be very liable to derangement from this cause.

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39. For a machine for *Heading Spikes and Nails;* Reneer Dare, Bridgeton, Cumberland county, New Jersey, January 27.

The pieces of nail rod, cut into lengths, are to be pointed by the hammer

in the ordinary way. The heading machine has two jaws, operating like those of the blacksmith's vice, and in these are fixed dies adapted to the shank of the nail or spike, which is to be placed in them, and the head formed by a hammer. The jaws are opened and closed, and the nail inserted and discharged in a manner described in the specification, and the claim is to "the method of holding up and discharging the nail or spike in the dies, for the formation of the head, and upset of the same." We are somewhat at a loss to discover the real value of the machine, as it seems to us that some of those which perform the whole operation of spike making, do it effectually, producing good work with much greater rapidity than can possibly be done with that before us.

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40. For a *Spark Extinguisher*, for Locomotives, &c.; Timothy Newhall, jr. Lynn, Essex county, Massachusetts, January 27.

The sparks are to be carried into the chimney, through a tube which is recurved after it enters it, so as to have its mouth downwards. Below this opening there is a box, or trough, to contain water, into which the sparks are to be driven by the force of the draught. To prevent the waste of water, and the return of the sparks, the mouth of the tube above spoken of, is furnished with what is called a conical funnel, and upon this, it appears, the utility of the apparatus depends. It is obscurely explained, and we really do not understand in what way it is to produce the contemplated effect; with the claim, therefore we dismiss the matter.

"What I claim as my invention, and desire to secure by Letters Patent, is the manner of applying the conical funnel for the purpose of preventing the waste of water; and this I claim in combination with the other parts of the apparatus with which it is connected, substantially in the manner set forth."

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41. For improvements in the *Machine for Cutting Lagging;* Benjamin B. Slade, Smithfield, Providence county, Rhode Island, January 27.

The stoves, or slats, which constitute the peripheries of the drums, or cylinders, used in cotton, or other, factories, is denominated lagging, and the undersides of these are to be cut concave in a degree corresponding with the size of the drum, or cylinder, of which they are to constitute a part. The intention of this machine is to cut every required size of curve by means of the same rotary cutters, which are affixed to the periphery of a revolving wheel, and cut crosswise of the stuff. It will be manifest that if such wheel is of the size due to the smallest curve, by passing the lagging over it, at right angles with its plane, the desired curve will be obtained; that if the cutters project over the edge of such wheel, and the stuff be passed over its face, the cutters would traverse its surface, and cut, or plane it flat; and it will be equally manifest that by presenting the lagging at the various inclinations between these two, every intermediate curvature will be obtained; this is the principle of action, and the following is the claim.

"What I claim as my own invention and desire to secure by letters patent is the platform hanging on swivels, and the slide gauge on the top of said platform, in combination with the rotary cutters; the whole constituting a *lagging machine* for cutting different sized circles with the same cutters, all constructed substantially as above described."

42. For a machine for *cutting or mincing Vegetables, Meat, and other substances;* John G. Conser, Rebersburg, Centre county, Pennsylvania, January 27.

This machine consists of a cylinder having knives set round its periphery, and revolving horizontally in a hollow cylinder, or concave, furnished with similar knives. These knives are placed obliquely, so as to give to the articles operated on, a progressive motion from the feeding towards the discharging end. The feeding is performed by means of a hopper on the upper side of the cylinder, at one of its ends. The claim is to "the arrangement of the knives, or cutters, on the cylinder, as before described; but no other part of the machine is claimed."

Specifications of American Patents.

Specification of a patent for an improved Parlour Stove; granted to Jordan L. Mott, *city of New York, December 7th,* 1837.

To all whom it may concern, be it known, that I, Jordan L. Mott, of the city of New York, have invented an improved parlour stove, which is furnished with air-heaters, so constructed as to economize fuel, and to supply air of genial warmth, which is not deteriorated in its passage through the heating flues. And I do hereby declare that the following is a full and exact description thereof.

Fig. 1.

Fig. 2.

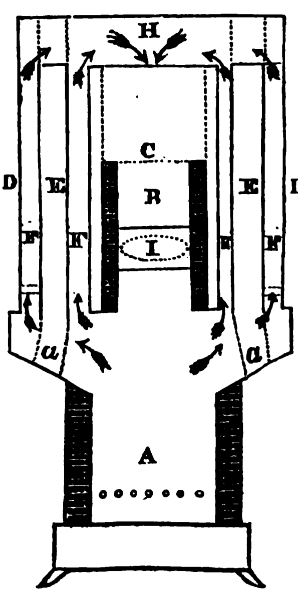


Fig. 3.

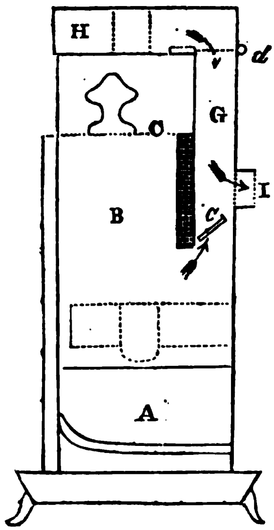


Fig. 5.

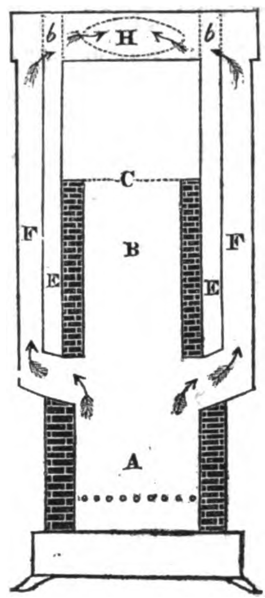


Fig. 4.

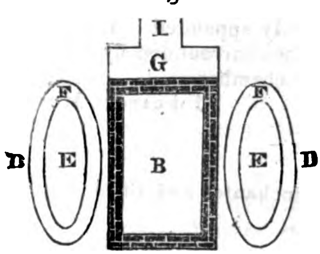


Fig. 1. in the accompanying drawing, is a perspective view of the stove. Fig. 2, is a vertical section through the middle thereof, parallel with its front; and Fig. 3, is a vertical section from front to back, through the middle.

In each of the figures, like parts are designated by the same letters of reference.

A, is the grate, or fire chamber, which is surmounted by B, a reservoir for coal, which has a close fitting cover at C, allowing a considerable quantity of fuel to be supplied at once, and to burn out gradually. D, D, are the combined flues, and air heaters, consisting of one cylinder, or rather oval tube, or chamber, within another, the innermost being the air chamber, and the space between it and the outermost the smoke flue. E, E, Fig. 2, &c., are sections of the inner or air, flues, and F, F, the spaces surrounding them, and forming the smoke flues. Air is admitted into the interior, or air, flue, at its lower end, through tubes, or apertures, leading into it, in any convenient way, as at the part represented by the dotted lines *a, a*; these tubes, or apertures, may be extended, if preferred, so as to admit air from without the room, but this will seldom be found necessary. The air which is heated in passing through these tubes, escapes into the room through openings at *b, b*, in the top of the stove.

The direction of the draught, or passage, for smoke and heated air, from the fires, is represented by arrows. There are, as in many other stoves, two directions for the escape of the smoke, &c., one directly to the escape pipe, and the other by a more circuitous route, which is to be used after

the fuel has become perfectly ignited. There is a flat flue, G, extending up from the fire-place to the chamber H, at the top of the stove; in this flat flue, there are two valves, or dampers, *c*, and *d*, by which the draught is governed. L, is the escape pipe for smoke, and into which it passes directly, when *c* is opened, and *d* closed; but when these valves are reversed, the draught is carried through the flues surrounding the air-tubes, and down the flue G, to the escape pipe. Fig. 4, is a horizontal section of the stove at the level of the escape pipe, the parts of which figure are designated by their proper letters of reference. By this arrangement of the flues, and of the air-tubes within them, the exterior, or shell, of the stove is directly heated by the heated air, and a free radiation takes place into the room. Fig. 5, shows a modification of this stove, in which the smoke flues do not entirely surround the air-flues, the latter being heated directly, on the side towards the reservoir B, but still through the intermedium of the brick lining, which, wherever it is represented, is coloured red. In other respects, the construction of this stove is identical with that before described.

Having thus fully shown the manner in which I construct and arrange the several parts of this stove, it is to be distinctly understood that I do not intend to claim these individual parts, generally, as my invention, they having been previously known and used.

All that I claim as new, and for which I ask Letters Patent, is the air chambers, or tubes, surrounded in whole, or in part, by the smoke flues, in the manner, and located, as herein described, in combination with the side openings, or apertures, that connect the smoke flue F, F, with the fire-chamber, whether said openings be under, or above, the surface of the fuel; and this I claim whether combined with a stove, such as that herein represented, or with one of any other construction, to which such side flues, so arranged and combined, can be advantageously appended. It being further understood that I make no claim to air-tubes surrounded by the smoke flues, when placed immediately above the fire chamber.

JORDAN L. MOTT.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the fallacies of the Rotary Steam Engine; by JOHN SCOTT RUSSELL, Esq., M. A., F. R. S., Ed.

The principles of the Rotary Steam Engine have been frequently adverted to in this Journal, and opinions indicating a want of confidence in them, (v. particularly Vol. XVII, p. 173) freely expressed by the editor. The Engine still continues to maintain its ground, and its claims to be put forth as a construction, preferable, especially for light work, in point of cheapness and efficiency, to that of the reciprocating engine. The motives for its adoption, with those who attempt to theorize upon it, are to get clear of the *loss of power* occasioned by the use of the crank and by the constant check which the piston undergoes from the necessity of its reverse or reciprocating movement. On these two points there have been much philosophical discussion, and much laboured and learned and unlearned disputation. Avery's Rotary Engine has been lately introduced into Scotland and its capacities highly extolled in some of the Journals. This has called forth several

learned papers in opposition to the objections to the reciprocating engine,—unfavorable to the rotary principle, and explanatory of the true doctrines of motive power and mechanical action.

The writer of the paper, an abstract of which is here given, enters with learning and research upon this interesting topic. His essay may be found at length in Jameson's Journal, vol. XXIV, p. 35, and an abridgement of it in the London Mechanics' Magazine, No. 776, p. 192. G.

Mr. Russel states:—"I have had the opportunity of examining and working the most successful engines of this kind ever produced, and therefore conclude that, had theory never led me to any such result *a priori*, I must have been convinced that practical experience was opposed to the rotary construction of the steam-engine. In what follows I shall endeavor to adduce my arguments in a form as little technical, as is consistent with precision.

1. It is first of all my wish to show that the subject of the rotary steam-engine is *not so new and untried* an invention as some who attempt the problem for the first time may be led to imagine;—for this purpose I adduce the names of more than ninety inventors, most of them patentees.

2. By an arrangement of these inventions, I have endeavored to show that *five different classes comprehend them all*, and that the others are mere repetitions of the same principle, and attended with the same failure; so that an inventor may know whether his invention contains an entirely new principle, and if it do not, that it has been already tried and failed.

3. By showing in one view, the names of inventors of unsuccessful rotary engines, I endeavor to convince the inventor that five classes already invented have *not failed from want of genius, skill, or practical experience*, in those who have made the trial, for the list contains the names of eminent practical men.

4. I endeavor to show that the *ordinary crank engine does not possess the defects attributed to it*, and which it is the sole object of the rotary engine to remedy,—that the use of the crank causes no loss of power.

5. In a practical point of view, the *rotary engine is every way inferior* to the reciprocating engine;—in simplicity, and cheapness, and ease of construction,—in durability and economy in use,—in uniformity of action and equable motion.

6. The rotary engine is *peculiarly inapplicable to the great purposes* of terrestrial locomotion and steam navigation—objects to which it has been considered peculiarly suitable.

7. That the *present steam-engine is practically perfect* as a working machine, being within ten per cent. of mathematical perfection.

8. That the *crank* of the common steam-engine possesses certain *remarkable properties* of adaptation to the nature of matter, of motion, of steam, and the human mind; from which its supremacy as an elementary machine is derived,—properties which cannot possibly belong to any species of rotary engine.

Rotary engines may be arranged according to the mode of action into four classes.

Class I.—Rotary engines of simple emission.

Class II.—Rotary engines of medial effect.

Class III.—Rotary engines of hydrostatical re-action.

Class IV.—Rotary engines of the revolving piston. As closely connect-

ed with the rotary engines in the fallacy which has given rise to both of them, we may add a series of inventions forming,

Class V.—Revolving mechanism substituted for the crank.

Class I.—The rotary engine of simple emission forms the earliest, as well as the most rude and elementary method of giving motion to mechanism, by the escape of vapour or steam. It is described by Hero of Alexandria, in his *Pneumatika*, upwards of 120 years before Christ, and depends, for its effect, upon the same principle which gives to a rocket its career, and makes a fire-wheel revolve in giving off its beautiful lights. In these, as in all instances where fire, or steam, or any fluid or gas is generated in a chamber from which it is permitted to issue with violence, it will, in its exit, drive the vessel from which it issues away from it in the opposite direction, and is, in fact, merely an application of the principle of recoil,—where the gas, generated by the explosion of the powder, urges the ball outwards in one direction, and forces the breech of the gun backwards in the opposite one. The same recoil is felt in all cases of simple emission of a fluid from a reservoir; and if it be so arranged that water, steam, air, or the gaseous productions of gunpowder, shall rush out of a chamber through the arms of a revolving wheel, the openings of escape being properly directed, the recoil will urge round the wheel, and we shall have a revolving engine of simple emission. By availing himself of this principle, the mechanist of Alexandria produced an efficient engine, merely by heating a vessel containing water and air, and allowing the vapour to rush from the two opposite orifices at the end of two arms proceeding from a sphere which the emission was employed to move.

Instead of using the principle of recoil, the force of steam issuing with violence as we see it from the mouth of a kettle or boiler, may be directed upon the vanes of a wheel, so as to blow them round; and thus we have a second variety in the manner of converting the simple issue of steam into a moving power. This second species of the rotary steam-engine of a simple emission was invented by Branca, in 1629.

Since that time the engines of this class have been frequently re invented and slightly modified.

Inventors of Rotary Steam-Engines of the First Class.

1.	Hero of Alexandria,	B. C.	130
2.	Branca,	A. D.	1629
3.	Kircher,	"	1643
4.	Dasiesme,	"	1699
5.	Kempel,	"	1785
6.	James Sadler,	"	1791
7.	Richard Trevithic,	"	1813
8.	Alexander Craig,	"	1834

The theory of machines of simple emission has been frequently and fully investigated, and the result is, that there is no possibility of obtaining, by simple emission, more than one-half of the whole power of the steam, so as to make it available to useful mechanical effect. The other half is wasted in giving off its impulsion to the air, or is expended in a current equally unavailing.

Practical experience corroborates the predictions of theory. Smeaton and Pelletan made the machines of simple issue the subject of careful experiment, and found that 3 parts out of 11, 8 parts out of 27, and 2 parts out of

5, are the highest measures of practical effect, that it has been found practicable to attain, and by no possible improvement can more than one-half of the whole power be turned to a useful effect.

Class II.—Rotary engines of medial effect are those which do not immediately give revolution to an axis by the action of steam upon the wheel, but have a *medium of communication* between the power and the effect, which medium is the direct agent in circular motion. This class of engines will be well understood by taking as its type any simple steam machine, such as Savary's and Newcomen's, used for raising water, which water by falling on the floats of a common mill wheel will then give rotary motion to it. The engine of Savary raises water by pressing directly on its surface, and it is only necessary to allow this water to fall on a wheel, when it will be made to revolve and form an engine of the 2nd class.

A variety of this class has been invented of which the fire-wheel of Amontons is a type. The stream pushes water through certain channels that form the arms of the wheel, from a set of chambers on one side of the wheel, to a corresponding set of chambers on the opposite; and thus the side filled with water preponderates over the other, and the wheel revolves The water being constantly driven off by the steam from a given side of the wheel to that opposite, uniform revolution is the result of the weight of the water. In this state, although steam is the agent, water is the medium of communicating the rotary motion.

Solids have also been made the medium of effecting rotation in this manner; weights of solid matter, in the form of pistons, have been transferred by the force of steam to a considerable distance from the centre on one side of a wheel; and drawn nearer to it on the other side, so as, by bringing about a continual preponderance on one side, to effect a revolution. Watt and Witty have designed rotative mechanism of this nature.

Inventors of Rotary Steam-Engines of the Second Class.

1.	Guillaume Amontons,	A. D. 1699
2.	Leopold of Plainitz,	" 1723
3.	Champion of Bristol,	" 1752
4.	James Watt,	" 1769
5.	Davidson & Hawkesley,	" 1793
6.	Richard Witty,	" 1810
7.	Sir W. Congreve,	" 1818
8.	John Moore,	" 1820
9.	Sir W. Congreve,	" 1821
10.	Thomas Masterman,	" 1822

In this class of engines the loss of effect is manifest, for it is necessary that the steam, in order to produce circular motion, shall give out its force in setting the medium in motion, and, in overcoming the very great resistance of the liquid in all the pipes, passages, and valves, through which it is transmitted to alternate sides of the wheel in every revolution; the whole of this force is subtracted from useful effect, and becomes power lost.

In those which move weights, from and towards, the circumference, there are mere groups of reciprocating pistons without cranks, and share the evils to be explained in Class V; in fact, in the engines of Watt and Witty of this class, we have *a series* of reciprocating engines ranged round a wheel to do the work of one.

In the case of the fluid medium, we have not only a loss of all the power expended in moving the medium itself, but also the additional loss of effect

encountered in all modes hitherto adopted for applying a fluid to the rotation of a wheel, a loss, in the best examples ever presented, amounting of itself to more than one-sixth part of the power.

Class III.—The engine of hydrostatical re-action is more effective than either of the former classes. As invented by Watt in 1769, it consisted of steam-vessels in the form of hollow rings, or circular channels, with proper inlets and outlets for the steam, mounted on horizontal axles, like the wheels and buckets of a water-mill, and wholly immersed in some fluid. This wheel was made of iron, six feet in diameter, and the re-action of mercury was employed to give revolution to it; the engine moved, but was found to be inefficient, and abandoned, although it has been tried in very favorable circumstances.

The principle of action is this: steam is admitted into a circular channel or chamber on the circumference of a wheel; this chamber is partially filled with some liquid, the pressure of the steam is expended in pushing the mercury in one direction, and the end of the chamber in the opposite way, so that while the liquid is thus forced out of the chamber, the chamber is by an equal force pushed away from the liquid; the wheel is thus turned round.

It is apparent that a part of the force is employed in propelling the wheel, and the remainder is expended in overcoming the resistance of the liquid of re-action, and expelling it from the chambers, which remainder is a large portion of the power withdrawn from useful effect.

Inventors of Rotary Steam-Engines of the Third Class.

James Watt,	A. D.	1782
Bryan Donkin,	"	1803

Class IV.—Rotary Engines, having a revolving piston, are constructed on a much better principle, and hold out much fairer prospects of a successful competition with those having the ordinary reciprocating piston, than any of the species of the three first classes that have been already considered. In these classes the steam is not confined in rigid vessels, but its action is applied to producing currents in fluids, and force is expended in medial effects which are useless, and therefore waste power. This is not the case with the steam-engine of the revolving piston. The steam is confined in a close and rigid chamber, and acts only on a solid inflexible surface, and makes its escape by confined passages, so that its full effect may be obtained in useful work. Abstractedly considered, it is an engine capable of giving out the full power of the steam, and therefore may fairly be imagined to come into competition with the ordinary reciprocating crank engine. The objections to it are entirely of a practical nature, and regard the engine not in its abstract mathematical form, but as a machine made of destructible matter, of matter imperfectly elastic, of surfaces opposing resistance to motion, of matter obeying the known laws of motion and rest. These objections are not the less valid that they are of a sensible and tangible, rather than a speculative description. But as a natural consequence of the more plausible deceptions held out by this species than by any of the three preceding ones, it has followed, that the fallacies of this class have been more widely seductive than any of the others. The Patent-office presents us with the names of more than forty victims, including some of the highest fame.

Inventors of Rotary Steam-Engines of the Fourth Class.

		A. D.			A. D.
1.	James Watt,	1782	24.	Robert Delap,	1821
2.	James Cooke,	1787	25.	Bambridge & Thayer,	1821
3.	Bramah & Dickinson,	1790	26.	William Foreman,	1824
4.	Edmund Cartwright,	1797	27.	Lord Cochrane,	1825
5.	Jonathan Hornblower,	1805	28.	L. M. Wright,	1826
6.	William Murdoch,	1805	29.	F. Halliday,	1825
7.	Jonathan Hornblower,	1805	30.	Joseph Eve,	1825
8.	John Trotter,	1805	31.	John Costigin,	1826
9.	Andrew Flint,	1805	32.	Marquis de Combis	1826
10.	William Lester,	1806	33.	Elijah Galloway,	1826
11.	Richard Wilcox,	1806	34.	Paul Steenstrup,	1827
12.	Thomas Read,	1808	35.	John Evans,	1828
13.	Edward Jane,	1808	36.	John Strut,	1830
14.	Samuel Clegg,	1809	37.	E. & J. Dakeigne,	1830
15.	William Chapman,	1810	38.	William Morgan,	1831
16.	John Trotter,	1811	39.	Samuel Hobday,	1831
17.	William Onions,	1811	40.	John Erricson,	1832
18.	Richard Thevitic,	1813	41.	Robert Stein,	1833
19.	Joseph Turner,	1816	42.	Elijah Galloway,	1834
20.	John Mallam,	1818	43.	Edward Appleby,	1835
21.	Joshua Routledge,	1818	44.	John F. Kingston,	1835
22.	William Carter,	1818	45.	John Yule,	1836
23.	John Rider,	1820	46.	John White,	1836

The fallacy of this class of engines we shall expose in conjunction with the next class, as the same misconceptions lie to a considerable extent at the door of both.

Class V.—Revolving mechanism substituted for the crank of the common steam-engine, for the purpose of obtaining from the reciprocating piston a rotary effect otherwise than by the crank, and in a better manner than by the crank, forms a class of inventions involving fallacies similar to those in which the revolving piston has originated. These two may therefore be considered together.

Inventors of Rotary Mechanism as a substitute for the crank.

		A. D.			A. D.
1.	Jonathan Hulls,	1737	13.	Edmund Cartwright,	1801
2.	Keane Fitzgerald,	1757	14.	Matthew Murray,	1802
3.	Gautier of Nancy,	1757	15.	Richard Witty,	1811
4.	John Stewart,	1769	16.	J. Dawes,	1816
5.	Dugald Clarke,	1769	17.	Tobias Mitchell,	1810
6.	Matthew Washborough,	1779	18.	Henry Penneck,	1827
7.	James Watt,	1781	19.	William Aldersey,	1821
8.	Thomas Burgess,	1789	20.	Robert Barlow,	1827
9.	Matthew Murray,	1779	21.	Thomas Peck,	1827
10.	William Lander,	1799	22.	Samuel Clegg,	1828
11.	Phineas Crowther,	1800	23.	William Lucy,	1836
12.	George Medhurst,	1801	24.	Charles Schafhautl,	1836

Although the name of Watt has been included in this list of inventors of substitutes for the crank, it should be observed, that he was only driven to the invention of such a substitute by the circumstance of a patent having been previously obtained for the crank in its simple form, and that he aban-

doned this beautiful, but more complex, mechanism on the instant that the elementary crank was released from the fetters of monopoly.

After combating with much demonstrative force the erroneous opinion of great loss of power by the crank, the author proceeds:

"In the reciprocating piston, therefore, acting through the crank, the whole power is found by multiplying the stroke and back-stroke, or twice the stroke of the piston, by the pressure upon it, and this is equivalent to the whole effect produced in the entire revolution of the crank; the pressure of the steam, and the space it moves through, are therefore the measure of the power.

In the revolving piston, the effect of the steam must be precisely the same, if the revolving piston be of the same size, and moves through the same space as the reciprocating piston; and if the revolving piston have a pressure on it equal to the mean pressure on the crank, and move through a circle equal to the circle of the crank, the effect will be the same in both cases.

Since there is no loss incurred by propagating the action of the steam on a reciprocating piston through the crank of a revolving axle, and since it is not in the power of machinery of any kind to augment the quantity of power given out by any mover, but merely to arrange, dispose, and modify that power to suit any given purpose, it follows that the rotary piston can have no purpose to accomplish, unless it excel the reciprocating one in simplicity and economy of construction, diminished bulk, durability, and economy in operation, facility of repair when deranged, diminished friction, or a peculiarity of adaptation to some individual purpose, such as steam navigation or inland transport.

I. As regards simplicity of parts, the engine with the rotary piston cannot excel the simplest forms of the reciprocating engine; take, for example, that form which merely consists of a cylinder, piston, and crank axle; where the cylinder, mounted on an axle, oscillates with the revolutions of the crank, which is immediately attached to the end of the piston rod, and which requires no moving valves of any kind, the steam being admitted and emitted through ports in the axle of the cylinder, which open and shut by the motion of the cylinder itself. Neither as regards facility and economy of construction does it possess superiority; for it will be readily granted to me, that whether the piston and channel in which it moves be rectangular or circular, they are more difficult of construction than a straight, round cylinder and piston, which being derived from the straight line and circle, are the simplest of forms, while an annular chamber, if the piston be rotary, is a surface of double curvature, of difficult construction and imperfect completion; if square, the construction of a rectangular piston is a still more troublesome attempt, the increased surface being increased expense and labor.

II. In point of bulk, the common reciprocating piston has a decided advantage; the annular cylinder of the revolving piston must be (to give equal power) about two-thirds of the area, and about three times the length of the reciprocating cylinder, being a bulk of cylinder nearly double. But even this is an estimate too favourable to the piston of rotation; the diameter of the axle requires to be very considerable; there are various reasons for this,—one is, that it is frequently a steam passage; another is that it is much larger than is required for the mere purpose of communicating the force; because any force of steam applied near the centre is of little value in pro-

ducing an effect, from the smallness of the circle which that part of the piston describes; and for this reason also, that the portion of piston exposed to leakage and wear is in proportion to the effect gained; the piston is therefore removed to a considerable distance from the centre, to answer the purpose, likewise, of rendering the revolution of the parts more nearly equal. These points will, however, have our attention at another time; it is sufficient for our present purpose, that these circumstances render it imperative to increase the bulk of the engine.

III. In point of durability and economy in its use, the most conclusive arguments lie against the rotary engine. I have seen many of them perfectly constructed, working beautifully, but they went very soon out of order. They invariably work best when new. This may appear to some to arise only from the defects incidental to particular modes of construction. I admit that many have had peculiar elements in their construction not indispensable to the principle. But, on the other hand, I shall now go on to show, that, independent of the idiosyncrasy of peculiar engines, the necessary mode of action involves elements of self-destruction very rapid in their operation, by means of which every rotary piston must soon wear itself out of condition.

It is a received principle in constructing machines, that, in a good engine, the parts should wear equally, and that even the very working of their parts should make them fit each other better. This is truly the case with the piston and cylinder, and other appendages of the reciprocating steam-engine. So true, that old engines of Messrs. Watt and Bolton—some of their earliest—are still working better than they ever did, or than some more recently made. To this the reciprocating engine necessarily presents a contrast: and it will not be difficult to show that its parts *must* wear unequally, so as to become unfit for use, and be rendered by each day's work less fit for the duty of the succeeding one.

To show the cause of this:—Suppose two perfectly flat plates of metal, perfectly round, to be laid one upon the other, so as exactly to coincide at every point. Let the undermost rest upon a table, and let the uppermost be made so as to turn round on an axis while in contact with the other, and let a rapid motion be communicated to the uppermost,—let me ask what will be the result of the attrition of the one of these upon the other? Will they wear equally, so as to remain in a state of mutual adaptation, or will they not? Experience furnishes an answer which exactly quadrates with reasonable expectation;—they will *not* wear equally,—they will *not* retain their forms. Let it be considered that the outer edge performs a larger circuit than any part nearer the centre; that, therefore, as all the parts revolve in the same time, those nearer the circumference move with a greater velocity than those towards the centre; that the attrition is more rapid at the circumference, and uniformly diminishes towards the centre of the plates; then it invariably follows that *the plates must become conical*, with a continual tendency to become more so. This is a most incontestible truth. It is one which has caused the failure of many beautiful inventions; it is the reason why conical bearings have been universally abandoned for cylindrical ones; and it is the cause that has rendered a most beautiful class of inventions totally useless to the improvement of the reciprocating engine. I allude to the flat *revolving valve* introduced by Oliver Evans, and afterwards brought into this country, but now universally abandoned, in spite of simplicity, efficiency, and economy, on account of this very attrition from a centre which we consider to be ruinous to every steam engine on a revolving principle.

The application of the result of this illustrative experiment to the subject in question, is abundantly obvious, the circumstance of rotation from a centre, with pressure on bearing surfaces of which the parts are at unequal distances from the centre, implies the excessive attrition of the circumferential surfaces above those which are near the centre, and which move with less velocity. Hence the circumferential surfaces wear more rapidly, and are unfit for use long before the central parts have suffered by any sensible effect. Where extensive metallic surfaces are in contact, their repair is a matter of much expense and delay.

To diminish this cause, or to delay its effect, the revolving piston is removed far from the centre of action. By this means, however, the bulk of the machine, and its friction, are very much increased, and the evil only partially remedied. It is obvious, however, that in this way, by increasing the radius, the engine is brought more nearly to the principle of the straight cylinder; so that perfection would just be attained if the circular cylinder were made straight, or, in other words, if the rotary engine were converted into an ordinary reciprocating engine.

When a piston reciprocates in a straight cylinder, all its points, and those of the cylinder, move equally, being in lines parallel to the axis; and to prevent accumulation of eccentricity, the piston may have its position on the circumference altered by part of a turn.

The essential nature of *rotary attrition* is therefore fatal to the success of the revolving principle,—a cause of expensive repairs, and speedy destruction.

IV. There are other defects to which this species of engine is peculiarly liable;—to vacuities and losses at the valves and passages—to irregular action, and collisions and shocks from the action of the parts one upon another; but these will be the subject of consideration as they occur in individual machines.

V. Unless, therefore, we shall find that there is some peculiar applicability in this form of engine above the common one, to certain important purposes, such as steam navigation and inland transport, we must abandon the hope of deriving practical advantage from the engine of rotation.

Now, it has been proposed for steam navigation, but to this it is peculiarly inapplicable. In a steam-vessel, it is useful to have the axis of rotation as *high*, and the weight of the engine as *low* as possible. Now, if the engine be placed on this axis, as it would be in the case of the rotary engine, one of two evils would follow; the axis would require to be much lowered, or the weight of the engine would be so high as to make the vessel the very reverse of steady. By such a disposition of its parts it must necessarily be rendered crank, and have its power greatly diminished. In the present engine, the weight is immediately above the floor of the vessel, and the axis in contact with the deck.

Applied directly to the axis of the steam-carriage or locomotive engine, there are insuperable objections to the rotary engine. As there would be no spring between it and the wheels, every jolt would derange the machinery. The weight of the engine, rigidly connected to the axle, would reciprocate the evil, and knock the wheels to pieces. These evils are prevented in the reciprocating engine, by the detachment of the engine from the axle, and the propagation of power through rods, wheels, or chains, to the propelling wheel or axis. It is indeed a radical defect in some of the existing forms of the locomotive engine, that the detachment is less perfect than might be desired. This very adjustment, so impracticable with the rotary engine,

was, even with the superior facilities presented by the form of reciprocating locomotion, one of the greatest impediments to the success of elemental locomotion.

VI. In addition to the above-mentioned advantages possessed by the reciprocating engine above the rotary one, it presents facilities (altogether wanting to the latter) for working directly the subordinate appendages of the steam-engine, such as cold water pump, its own feeding pump, &c. If the engine be a condenser, the simplicity of the reciprocating mechanism of the air-pump puts the rotary engine altogether *hors du combat*.

VII. All these considerations, of the most important practical bearing, demonstrate clearly to us, that if there be no very considerable loss of power in the reciprocating engine, we have little inducement to make the substitute of the rotary chamber and revolving piston for the cylinder and reciprocating piston.

It appears, on the contrary, both from theory and practical working of the steam-engine of ordinary construction, that, with a very small allowance for friction, the piston gives out through the crank, in actual work done, all the power of all the steam applied to it in the cylinder. Mechanism can do no more. And since neither simplicity of action, compactness of form, condensation of bulk, nor economy, either in the first cost or operation, gives it a superiority to the common engine, but that, on the other hand, from the very nature of its movement, it possesses the elements of rapid detrition and unequal deterioration, and is, by the necessary arrangement of its parts, rendered peculiarly inapplicable to such important objects as the purposes of steam navigation and land transport, I do not see what motive can possibly remain for devoting a single thought to its further improvement, or the alteration of its form, when its very principle holds out no higher premium than that, if brought to its utmost perfection, it might possibly approach in durability and efficiency the ordinary reciprocating engine, but in no point of view could ever excel it. To expend more time and mind on such a subject, is therefore merely sowing the wind to reap the whirlwind.

VIII. The force of the exposure I have now been induced to make of the fallacious nature of those attractions by which the rotary motion has drawn aside ingenious mechanists from the direct path of legitimate invention into the fruitless pursuit after ingenious trifles, will have considerable weight added to it, if we turn our attention to the *peculiarities of the crank*, as one of the elementary machines for the conversion of reciprocating into rotary action.

The crank, as the means of converting the reciprocation of the piston of a steam engine into a continuous rotary action, possesses singular and beautiful properties, which distinguish it from every other means of producing that conversion, and which appear to be so perfectly adapted to the nature of steam and the constitution of solid matter, that we are indebted to it materially, although indirectly, for the very great advantages we derive from the modern steam-engine as a source of mechanical power. Ingenuity has been taxed to the utmost to find substitutes for it, which should remedy the (imaginary) defects of the crank, but the mighty element has disdained them all, pounded them to powder, and thrown them from her. Like unskilful keepers, they have attempted to control a power by means which have only encountered the force they were designed to direct; and, after many vain efforts, it is found that the crank is the magic rod under which alone the mighty force of the element becomes peaceful and docile. Wheels, sectors, and racks, in various combinations have been made to as-

sume the functions of the crank, but they have uniformly been declared incapable. Once or twice it has happened that a substitute was obtained, but it was soon found that these (the sun and planet motion, for example,) were only cranks in disguise; and the useless mask was speedily dispensed with when the cause of its assumption had ceased to exist. It was an invidious patent alone that induced the immortal Watt to give the name of sun and planet to two wheels, placed one at the base and the other at the apex of the crank. The disguise appeared as the patent expired, and the simple unencumbered crank resumed its well-merited station.

The peculiarities of the crank which give it its unapproachable perfection as an elementary machine, I shall now go on to describe.

1st. I would observe, that in the reciprocating piston of a steam-engine the following things occur :—The piston is to be put in motion in one direction, then stopped; then put in motion in the opposite direction; stopped again; motion in the original direction once more begun and made to cease. At the commencement of the motion downward, a valve is to be opened for the entrance of the steam above the piston, which valve must be closed at the end of the stroke, and at the same instant in which one steam-valve closes, an opposite one must be opened to admit steam below the piston; at the same instant, also, a valve of eduction for the first portion of the steam must be opened, and a second valve of emission on the opposite side of the piston closed. At one and the same instant, therefore, the motion of the piston has to be stopped in one direction, and commenced in the opposite direction, one steam communication closed, a second opened, a third of eduction cut off, and a fourth renewed, and all this (for the perfection of the engine,) must be done with the most absolute precision.

But these processes, which produce the change of state from rest to motion, and from motion to rest, require time. Matter acquires momentum which must be gradually removed, otherwise that matter is subjected to concussion, as if by the stroke of the hammer, and either suffers or produces injury. And, on the other hand, when in motion, matter requires a force to stop it equal to the force that gives it that motion. These effects therefore, cannot be instantaneous;* and it is necessary that while the motion which the steam gives off be uniform and continuous, the parts of the engine itself shall be allowed time to be brought to a state of rest, without shock, concussion, or jolt, and as gradually and gently be again urged to their greatest velocity in the opposite direction. *All these with exquisite adjustment the crank effects;* it stops the piston as gently and softly as if it placed beneath it a cushion of eider down, and afterwards as gradually begins and accelerates its motion to its highest velocity in the opposite direction. The valves too, are opened with the same perfect adjustment, being performed with that gradual motion which proportions the largeness of the aperture to the supply of fluid required to be transmitted. An adjustment so complete could only take place by such a relation as subsists between the crank and piston, the one describing uniformly the circumference of a circle, while the other moves by simultaneous gradations of alternately increasing and diminishing extent. But this is not all that distinguishes the crank.

2d. It is one of the highest recommendations of a piece of mechanism, that any very slight error in its construction shall not very materially pre-

* "On sait que pression ne peut pas produire tout-à-coup une vitesse finie."—Lagrange, Mech. Analyt., p. ii. sec. x.

vent its usefulness; nor any slight derangement of its adjustment be attended with immediate destruction, but that on the other hand, the *efficiency of the mechanism shall be consistent with such degrees of correctness as ordinary workmen can accomplish, and with such care as ordinary attendants can be trusted to bestow;* also, that the process of disrepair shall be so gradual as to give timely warning of the necessary re-adjustment. Just such a piece of mechanism *is* the crank. It is at the top and bottom of the stroke, or in the line of the centres, as it is technically called, that the opening and shutting of the valves should take place; and it is just at this point that pressure on the piston can produce any effect on the crank; but suppose the valves not to open with absolute precision, suppose them to open and shut too soon or too late, then will the error at that part of the circuit be of comparatively small importance, because *just then*, the motion of the piston is so slight, that, through an arc of twenty degrees, it does not describe one hundredth part of a stroke, and the effect of any error in that space will not affect the crank by more than one hundredth part of its amount; any *error of adjustment is therefore diminished in effect to one hundredth part* of what would be produced, were the motion of the piston to be uniform in portions corresponding to the arc of description, as would be the case in any other species of rotary conversion.

3d. In like manner, errors arising out of construction, management, or wear, are diminished one hundred-fold by transmission through the crank. It has been to me a matter of frequent astonishment, that although I have seen at the mouths of coal-pits, small mines, and quarries, mere remnants of engines, frail rusty old fragments of iron and wood, working so loose as scarcely to remain upright upon their basements, they were still working within 30 per cent. of their full power.

4th. To all these circumstances, I may add, that the constitution of the crank is one reason why an engine may be constructed of enormous weight, and of the most unwieldy dimensions, without being thereby much injured in its working; because the crank acquires so slow a motion at the commencement and termination of the stroke, that it equally slowly communicates motion to all parts of the machine, and in a like manner receives from them the impetus which they give out in the act of being again slowly brought to rest towards the end of the stroke. The impetus, therefore, given to the reciprocating parts of the machine is *lent* not *lost*.

We have thus endeavoured to expose the nature of the fallacy under which they labour, who imagine that the present steam-engine, as derived from Watt, is a machine which "destroys" or "absorbs" a larger portion of the power it is designed to transmit, and who look to the rotary engines as a means of increasing the amount of the power given out in useful effect. That the rotary engines, which appear day after day, are not new, we show from the fact, that the five great classes which comprehend them all have been invented and re-invented by upwards of ninety individuals. That their inventions have been unsuccessful, is manifest, from the non-existence of their machines in the daily use of ordinary manufactures. That the failure of these contrivances did not arise from defects accidental to the peculiar arrangements and contrivances of the engines, is rendered probable by the great variety of forms in which they have been re-invented, tried, and abandoned. That they have not failed from deficiences in the workmanship and practical details, is rendered still more probable by the circumstance of finding among the names of inventors, those of the most eminent practical engineers. We have next shown that in theory, the crank

of the steam-engine in common use, cannot, as has been supposed, be attended with a loss of power, as such loss would oppose the established doctrines of virtual velocities; it is shown also from very simple and elementary considerations, that what appears to be lost in force, is resumed in velocity— that, in proportion as the mean force on the piston is greater than the mean force on the crank, in that proportion is the space described by the latter greater than the space described by the former. That the dynamical effect produced in a given time is exactly in the proportion of the steam expended in that given time; and thus we have arrived at the conclusion, that the common reciprocating crank steam-engine has not the faults attributed to it in theory, and which the rotary engines have been designed to remedy. We have next taken the practical view of the subject—in simplicity of parts the rotary piston has no advantage over the reciprocating piston; in difficulty of construction the rotary piston far exceeds the reciprocating engine—it is more expensive at the outset—it has more friction—it is more bulky, and less compact—it is inferior in precision and uniformity to the crank engine—and there is a radical fault inherent in the very nature of rotary mechanism, from which it follows that the rotary engine can never be rendered either an economical or a durable machine. We have further shown that, even if rotary engines could be made economical and durable, their very nature renders them unsuited to the great purpose of steam navigation and inland locomotion,—objects to which they have been considered peculiarly applicable. We deemed it an appropriate and instructive conclusion to our enquiry, to examine into the action of the crank, for the purpose of discovering what those remarkable qualities are which have given to the crank of the common steam-engine, its unrivalled superiority as an element for the prodnction of circular motion, and a degree of perfection unattainable by any other mechanism. We have seen that well-constructed crank steam-engines are daily performing duty, which is within ten per cent. of the theoretical maximum of possible effect—of absolute perfection—that this practical perfection arises from the simplicity of the crank, from its wonderful adaptation to the nature and laws of matter and of circular motion in connexion with rectilineal motion—from its reduction of errors either in construction, adjustment, or management, so as to work well without the absolute necessity of greater intelligence, expertness, and precision, than belong to ordinary workmen; and from the compensating nature of the arrangements of its structure, by which it is accommodated, in a remarkable degree, to the necessary imperfections of all human mechanism.

It is my earnest desire, that this exposure may have the effect of inducing some of my ingenious countrymen to direct their exertions for the advancement of the arts and industry of Scotland, to other and more promising subjects of invention. A wide field is open to their exertions in the useful *applications* of the mechanical powers of the common steam-engine to the wants of growing civilization, and to the improvement of the condition of the human race. Let them direct their exertions to these objects, with the industry and unity of purpose which they have already displayed in the pursuit of the fascinating fallacy of a rotary steam-engine, and they will one day be reckoned in the glorious list of those who have been the benefactors of their kind, and the ornaments of Scotland.

Lond. Mech. Magazine.

Bichromate of Perchloride of Chromium.

This remarkable compound was discovered by Berzelieus; it was at first called perchloride of chromium, because when put into contact with water it was changed into chromic and hydrochloric acid. Its true composition was ascertained by M. Heinrich Rose.

M. P. Walter gives the following process for preparing this compound: put into a tubulated glass retort an intimate and finely powdered mixture of 100 parts of fused common salt, and 168 parts of neutral chromate of potash; an S tube is to be put into the tubulure of the retort, through which there are gradually poured 300 parts of concentrated sulphuric acid. The action is rapid from the commencement; intense red vapours, accompanied by much chlorine, are disengaged. The receiver is to be kept cold to condense the vapour. The acid must be gradually added, or otherwise a loss of the red vapours will take place, and besides this the contents of the retort rise and pass into the receiver. As soon as the acid is added, the retort is to be gently heated, and the heat is to be increased, until yellow vapours begin to arise; the operation is then finished. In the receiver there is found a liquid of an intense red colour, and a solid substance, which, according to M. Dumas is a compound of this substance with chlorine. By decantation they may be separated, and the liquor when rectified, so as not to obtain the whole of it, yields a compound, the boiling point of which is constant.

The liquid thus obtained is of a magnificent blood-red colour; it is volatile, and yields fumes abundantly; when put into a quantity of water it falls to the bottom in drops of an oily appearance, and is converted into chromic and hydrochloric acids. Its boiling point is 244° Fahr., and its specific gravity is 1.71; it acts rapidly on mercury; it is decomposed by sulphur, detonates with phosphorus, dissolves chlorine and iodine, and combines with ammonia with the disengagement of light. A small quantity mixed with concentrated alcohol combines with it with violent explosion, and the inflamed alcohol is projected with force. This unexpected action had nearly deprived M. Walter of his eyesight, and burnt him horribly.

The analysis of this substance by M. Walter, agrees with that of M. Rose, namely,

Oxygen, ...	19.28	
Chlorine, ...	45.14	
Chromium, ...	35.58	100.

Am. de Chemie, et de Physique, 66-391.

It appears to me that it would be more simple to consider this compound as an oxichloride of chromium, than a bichromate of perchloride of chromium. It might then be regarded as composed of

Two equivs. of Oxygen, . . .	16	or 20
One equiv. of Chlorine, ...	36	45
One equiv. of Chromium, . . .	28	35
	80	100

Lond. and Edin. Philos. Mag.

On the action of Fermentation on a mixture of Oxygen and Hydrogen Gases; by M. Theod. De Saussure.

It is well known that the quantity of hydrogen gas contained in the atmosphere does not amount to 1-1000dth of its volume. Nevertheless th

decomposition of organic matters continually adds fresh quantities of this gas to atmospheric air; on the other hand there are few substances which occasion the combination of hydrogen with oxygen at common temperatures; and the circumstances which the combination requires, prove that the disappearance of the hydrogen cannot be accounted for in this way. M. de Saussure states that he has found that the combination is effected by the fermentation of organic substances universally distributed over the surface of the soil, even when on account of the smallness of their quantity and the slowness of their operation no rise of temperature takes place.

By exposing fermentable bodies in pieces of the size of a nut to the mixed gases, M. de Saussure has arrived at the following conclusions:—The combination of hydrogen and oxygen gases may be effected without inflammation at the temperature of the air, by bodies submitted to slow fermentation.

They usually produce this combination when they are accumulated and impregnated with a sufficient quantity of water to prevent their complete contact with the oxygen gas. If this contact be made by increasing the surface of the fermentable body, or by diminishing the quantity of water, the hydrogen gas is not absorbed, and the oxygen gas disappears in other combinations.

The porosity of the fermenting body greatly contributes to the destruction of the detonating mixture.

Many observations prove that the hydrogen gas which disappears by fermentation combines with the oxygen gas, in the proportion of the elements of water. The demonstration requires that the oxygen shall be employed only to form this water, and all the carbonic acid produced in the operation.

The fermentable substances mentioned in the memoir do not effect the combination of the oxygen and hydrogen gases before they ferment, nor when the fermentation is stopped by an antiseptic. Soils and humus, mixed with different earths, undergo a slow fermentation as soon as they are moistened, which gives them the power of destroying the mixture of oxygen and hydrogen gases.

Gaseous oxide of carbon, and carburetted hydrogen gas, obtained by decomposing water with red hot iron, were not destroyed by fermentation when they were substituted for common hydrogen gas, in the explosive mixture formed of two volumes of hydrogen gas and one volume of oxygen gas. Azotic, hydrogen and oxygen gases, added to the explosive mixture, do not present any remarkable obstacle to the destruction of an explosive mixture by a fermenting body, nor to that which is effected under the same circumstances by a plate of platina recently cleaned.

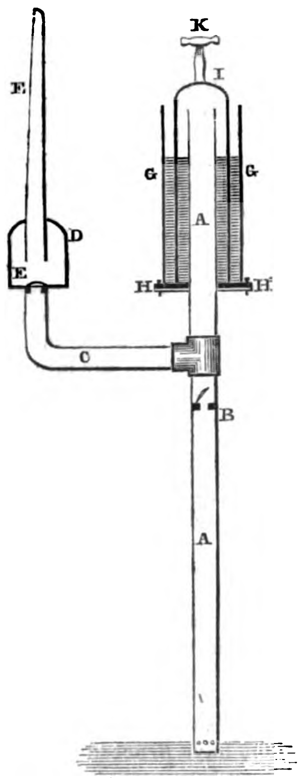
Oxide of carbon, and olefiant gas and others, which prevent the combination of oxygen and hydrogen by platina, are also great obstacles to the same result of fermentation.

Nitrous oxide, added to the explosive mixture, was partly decomposed by fermentation, and did not prevent the combination of the hydrogen and oxygen gases.—*Bibl. Univ. Feb.* 1838. Sup. to Lond. & Edin. Philos. Mg.

Mill's Mercurial Pump.

Sir,—Some time since I constructed a mercurial pump, on what I conceive to be a new plan. I presented a working model to Mr. Grier, lecturer on Natural Philosophy in the Baronial Hall, who exhibited it to his class,

and the action was so satisfactory to the lecturer and his audience, that I have been solicited to transmit you an account of the pump, which I hope you will not consider unworthy of notice in your excellent periodical.



The pump is of the suction kind; A, A, is a pipe not more than 30 feet in length, opened at both ends, the undermost of which is inserted in the well to be drained. At B, there is a clack valve opening upwards, immediately above which a branch pipe, C, leads off, and opens into an air vessel, D, of the ordinary construction. The top of the pipe, C, is furnished with a valve, E, opening upwards into the air vessel, and the ejection pipe is terminated at the required height, F. Immediately above the branch pipe, C, the main pipe, A, A, is begirt with a cylinder, G, G, of iron or glass. The cylinder is of greater diameter than the pipe, but screwed to it at the bottom, H, H, so as to be perfectly air-tight. The cylinder rises to the same height as the pipe, A, A, and the space between them is nearly filled with mercury. A cylinder open at the bottom, and of a diameter intermediate between the cylinder, G, G, and the pipe, A, A, is immersed in the mercury over the pipe, after the manner of a gas holder receiver, but so as to be capable of an easy motion upwards and downwards. The top of this cylinder is furnished with a handle, K. In consequence of the mercury in the cylinder, G, G, and of the valves, B and E, no external air can enter the main pipe, A, A, which enters the well; but the cylinder, I, being lifted by the handle, K, yet not so far as to come out of the mercury, the air within the pipe, A, A, will be rarified, and the pressure of the atmosphere will force the water from the well up the pipe, A, A, so as to pass the valve, B, which opens for its passage. When the cylinder, I, is brought down, the valve, B, shuts, the air is compressed, and the water having no other way of escape, passes through the tube, C, through the valve E, and into the air vessel, D, thence up the pipe and becomes discharged at the orifice, F.

The advantage of this pump is, that little friction is encountered, and for every inch of stroke of the handle, K, the water will be raised one foot.

James Mills.

Glasgow, 13, Clyde Terrace, March 30, 1838.

Lond. Mech. Magazine.

The foregoing is a somewhat novel application of a principle familiar to all who are accustomed to the raising and depressing of air jars in a hydro-pneumatic or mercurial cistern. G.

A New Water Power.

The discovery of a new application of water power, which is likely to be attended with the most important consequences, has lately been made

by a tradesman in Greenock. Like all truly valuable discoveries, it is distinguished alike for simplicity and efficiency. It consists of a cylinder and a piston similar to those employed in the steam-engine. To the cylinder there are two entrance and two discharge pipes, one of each on each side of the stuffing box of the piston. The same turn of the cock that admits the water into one part of the cylinder opens the discharge pipe in the other, and thus a vacuum is formed. To work this, advantage is taken of the pressure of the Shaw's Water Works, the height of the reservoir of which gives it a force of 60 lb. to the inch, in the lower parts of the town of Greenock. A short time ago, an experiment was tried with a cylinder 2 in. in diameter, worked with a jet of water of somewhat less than a quarter of an inch in diameter, and the piston, although loaded with 1½ cwt., rose and fell 16 times in the minute. In this case the entrance and discharge pipes were equal in size, and the cylinder was placed in a vertical position. Since then, the discoverer has had another model with the cylinder laid horizontally, and with the discharge pipes nearly three times as large as the entrance ones, and by this means the motion was increased to 26 double strokes in the *minute*. The cheapness of an apparatus of this kind, and its efficiency, wherever there is a sufficient height of water to work it, must be obvious to all, while its manageableness and freedom from danger are no less conspicuous. The merit of this discovery is due to Mr. William Allison, a mason of Greenock, who first suggested this novel application of a well known power to Mr. James Baird, engineer, and Mr. A. Fairgrieve, plumber, who had materially aided him in reducing it to practice. One use to which Mr. Allison conceives it to be peculiarly applicable is, the hoisting of heavy goods into warehouses. The Shaw's Water Company, for *7l.* a year, gives a supply of water equal to 1000 gallons per day. This water injected into a cylinder 10 in. in diameter, he calculates, will raise to the second floor 300 tons per day; to the third floor, 200 *tons*; to the fourth, 150; and to the fifth, 100 tons. The cost of the water for each day's work is about *5d.* The goods in question will be raised at the rate of 39 ft. per minute. These calculations have proceeded upon the pressure of the water introduced into the town for domestic purposes; but a pipe from the Compensation Dam at the Paper Mill, from its superior height, would give a pressure of about 200 lb. on the inch.—*Greenock Advertiser* as quoted in the *Dumfries Courier*, Sept. 6, 1837.

Arch. Mag.

Whatever ingenuity there may be in the mechanical arrangements of the engine here described, there is nothing new in it with respect to the application of the principle on which it acts. G.

Articles from the French Journals. Translated for the Journal of the Franklin Institute, by J. Griscom.

On the density of Clays, baked at various temperatures; by Aug. Laurent.

It is well known that certain clays have the property of diminishing in volume when heated, and that this diminution increases with the temperature; whence it might be inferred that the density increases in the same

proportion. This conclusion, however, is not accurate, and though the contrary may appear absurd, the absurdity is only apparent, as I am about to demonstrate.

Having cast a prism of kaolin diluted with water to render it more homogeneous, and dried it at about 150°.

Its length was, -	0m.236
Its weight, - -	10gr.852
Its density, (in powder,)	2.643

I exposed the prism, during 6 hours, to a red heat, capable of melting an alloy of three parts silver and seven of gold.

Its length was, -	0m.233
Its weight, - -	9gr.852
Its density, (in powder,)	2.643

Thus far nothing remarkable appears. The volume diminished and the density increased, but not in the same proportion, for there was a change of chemical constitution, since the hydrosilicate of alumine lost about eight and a half per cent of water.

The prism was then heated about six hours at a temperature capable of melting an alloy of equal parts of gold and platina, (temperature of assays of iron.)

Its length became,	0m.212
Its weight,	9gr.814
Its density, (in powder,)	2.481

If its length and weight be reduced to a centesimal scale, we have

	at 150°	at a red heat.	at a white heat.
Length,	100	98.72	90.98
Weight,	100	89.62	89.66

From the red to the white red heat the weight remained sensibly the same while we see that the volume was considerably diminished. It was the same with the density which from 2.643 changed to 2.481.

Having taken another piece of kaolin, I heated it successively, at various temperatures, taking the density each time, and obtained the following results:

	Density.
At 100°	2.47
At 150°	2.53
At 300°	2.60
At a dark red	2.70
At a bright red	2.64
At a temperature somewhat inferior to an iron assay,	2.50
At the iron assay temperature,	2.48

The volume diminishing continually from beginning to end, we perceive that the density increases by degrees to a dull red, at which it is a maximum; that the weight diminishes equally as far as this temperature; and that from this point the density diminishes as well as the volume, while the weight remains constant.

It is very easy to account for the diminution of the density beyond the dull red, considering that the volume, measured in mass, is only an apparent volume, composed of the real volume of the particles and the volume of the air which separated them from each other. By the heat, the parti-

cles approached each other, the intervening air being expelled, and they increased in volume, at the same time. It is similar to what would be observed if we were to take a cubic litre of the filings of beaten gold, melt it and find that it occupied but half a litre, and then ascertaining that the density of this melted gold, reduced to powder, is less than that of beaten gold. As to the cause of the increase of volume of the particles of clay, we may attribute it to the combination which gradually takes place between the molecules of silica and alumina, which are only mixed or partially combined in the unbaked clay. This is conformable to experience which teaches us, that almost always, when two bodies combine, the compound has a density less than the mean density of the two component materials.

Ann. de Chim. et de Phys.

Action of Iron on Benzoic Acid at an elevated temperature; BY FELIX D'ARCET.

In passing the vapour of Benzoic acid over iron at a red heat, we obtain a yellowish oil, fluid, and having an impregnated odour mixed with that of bitter almonds.

This impure oil, distilled in a sand bath, leaves a residuum of tar, and a very fluid colourless liquid distils over, of a peculiar odour.

This liquid boils at 86°, C. At —6° it congeals.

A quantity weighing .235 gr. treated with the oxide of copper, gave .168 gr. of water and .794 gr. of carbonic acid.

Its composition therefore is,

Carbon,	92.065
Hydrogen,	7.935
	100.000

which gives the formula $C.^{24}$ $H.^{12}$

		Calculated.	Found.
C^{6}	229.5	92.4	92.06
H^{6}	18.7	7.6	7.94
	248.2	100.0	100.00

This material is therefore Benzine, and its formation is explained in the following manner.

C^{28} H^{12} O^{4} Benzoic acid,
C^{24} H^{12} Benzine produced,

C^{4} O^{1} Carbonic acid.

When the temperature is raised, carbonic oxide is obtained; but if the temperature is lowered, to a dull red, for example, carbonic acid only is collected.

Benzine may also be obtained, by distilling a mixture of benzoate of potash and arsenious acid. I have had this reaction in seeking a body analogous to the liquor of *Cadet*.

Ibid.

Action of Iron upon Camphor at an elevated temperature. BY M. F. D'ARCET.

In directing the vapour of camphor over iron at a red heat, an oleagi-

nous liquid gathers in the receiver which is very fluid and of a yellow colour.

In distilling this first product in the sand bath, nothing is obtained, and it becomes necessary to raise the temperature to about 145°, then a vapour passes off, and a liquid, slightly yellow, is formed, lighter than water, of a peculiar aromatic odour, having no resemblance to that of camphor, if the operation be slowly conducted.

.187 gr. of this material gave .129 gr. of water and .622 gr. of carbonic acid, by burning it with oxide of copper,—whence its composition is

Carbon,	92.35
Hydrogen,	7.65
	100.00

and its formula; C^{24}. H^{12}.

		Calculated.	Found.
C^{24}.	918.0	92.43	92.35
H^{12}.	74.8	7.57	7 65
	992.8	100.00	100.00

This substance boils at 140°; its composition is exactly the same as that of benzine, but its properties are very different. Can it be a new case of Isomerism? Time does not allow me, at present, to study it with the requisite care: on my return, I shall resume the task and endeavour to clear up this reaction. I have, besides, observed, that when the operation is performed at an elevated temperature, independently of the liquid above obtained, napthaline is also formed. Ibid.

Preparation of metallic Candle Wick.

Melt 100 parts of tallow, or wax, or any mixture of these, and add 5 to 10 parts of carbonate of lead well pulverised. The materials easily unite by stirring. Steep the wicks in this composition while warm and fluid. When cold the candles may be made upon them by dipping or moulding. In burning these candles the carbonate of lead is decomposed by the heat, and little globules of lead collect on the top of the wick, which bend it out of the flame and thereby increase the beauty and brightness of the light.

Jour. de Conn. Usuelles.

Improvements in Areometers and Thermometers; By M. Dinocourt.

The scales of the French Areometers or Pese-liqueurs are traced on a strip of paper which is introduced into the glass tubes which form the stem of the instruments, and is attached to it by a little sealing wax. These paper scales are liable to become displaced, especially when the instrument is dipped into warm, or hot, water, and thus its value becomes completely vitiated by giving false indications.

This inconvenience has been sometimes avoided by marking the degrees of the scale with a diamond, or by fluoric acid, but this method has been given up in consequence of the difficulty of reading the divisions when thus made, and more especially from the weakening of the glass which they occasion.

M. Dinocourt, agreeably to a report made by Francoeur to the *Société d'Encouragement* has much improved these instruments by giving the marks

an invariable position on the stem, and at the same time preserving their easy legibility. These he effects by using an enamel powder mixed with gum, tracing the divisions and figures with a pencil, and then by exposing the glass to the flame of an alcoholic lamp so as to bring it to a red heat, the enamel becomes fixed to the glass. Great address is required in this operation so as not to injure the accuracy of the instruments, but Dinocourt executes this delicate work with perfect success.

As strong acids would corrode the enamel, the artist, in the construction of his pése-acides, marks his divisions with gold, which is proof against all but the nitro-muriatic. Various methods have been tried to attach the paper scales immovably to the stem by narrowing the neck, by a spiral wire, by rims of glass soldered to the stem, but none of these expedients have been satisfactory. M. Dinocourt, says the reporter, appears completely to have solved the problem. It is true that his Areometers cost more than the common ones, (his price being from 2 to 3 francs,) but the difference is more than compensated by their superiority.

Thermometers to be used for taking the temperature of acid fluids require similar precautions. M. Dinocourt has applied his improvements to these instruments with the same success. His thermometers cost but five francs.

Bull. d'Encour't.

New method of analysing the Ores of Manganese; By M. Ebelmen.

The process I would recommend appears to me susceptible of great exactness, and it has the advantage of being very easy of execution. It consists in receiving the chlorine, disengaged by muriatic acid from the ore, in a solution of sulphurous acid thoroughly freed from sulphuric acid, and saturating the sulphuric acid produced by muriate of Barytes.

Put a gramme of the ore to be tried, reduced to a coarse powder, in a small vial to which is adapted a bent tube, and pour on it a convenient quantity of muriatic acid. Let the chlorine disengaged pass into a flat bottomed receiver of about 8 oz. about two-thirds full of a solution of sulphurous acid. The chlorine may be disengaged very rapidly as the absorption is always complete as long as sulphurous acid remains in the solution which may be determined by bringing the nose to the edge of the receiver. When the muriatic acid begins to lose its brown tint, the ebullition must be rapidly urged to prevent absorption and to expel completely the disengaged chlorine. Then add muriate of barytes to the sulphurous acid solution, and boil it to drive off all excess of sulphurous acid. Clear the deposite by filtration, and the sulphate of barytes thus obtained gives the proportion of oxygen sought. An atom of sulphate of barytes $\dddot{S}\,Ba = 1458.09$ corresponds to 100 of oxygen. The chlorine in acting on the sulphurous acid solution, reproduces the oxygen which was disengaged from the ore in passing to the state of protoxide: now 100 parts of this oxygen enter into the composition of 1458.09 parts of sulphate of barytes, and I have elsewhere proved that hyposulphuric acid is never formed by this re-action whatever might be the excess of sulphurous acid, for in evaporating the liquor freed from sulphate of barytes to dryness in muriatic acid, and taking it up with water, no traces of sulphate of barytes remained.

The advantages of this process appear to me to be—1st. We are certain that the process at every instant is going on well, that the whole of the chlorine is absorbed and that nothing is lost at the stopper. 2d. That the ore is completely attacked and in a very short time. 3d. This mode presents

an advantage over that of digesting the manganese in sulphurous acid itself, which is a slow process, and which moreover takes from the oxygen of the manganese that which converts the oxide of iron to a protoxide, and therefore does not give the true value of the ore in relation to the chlorine it may produce. Finally, by the last named method, a great quantity of hyposulphate of manganese is formed, the decomposition of which is long and difficult.

Instead of employing sulphurous acid of recent preparation, we may use solutions of long standing and which contain, of course, sulphuric acid. It is sufficient to add to these a certain quantity of muriate of barytes; as oxygen is absorbed, sulphate of barytes is precipitated. When used, decant the clear fluid. The chlorine is then passed into a mixed solution of sulphurous acid and chloride of barium; each bubble of chlorine gives rise to a portion of sulphate of barytes. Annales des Mines.

Crayons for Drawing on Glass.

Take equal quantities of asphaltum and yellow wax and melt them together. Add lampblack sufficient to give the mixture the requisite colour, stir it well, and pour it in moulds for crayons.

The glass should be well wiped with leather, and in drawing care must be taken not to soil the glass with the fingers.

It is sometimes difficult to trim the crayons with a common knife, for if too sharp it cuts in too much, and if too dull it cannot make a fine point. But if the edge be bevelled like scissors, and very sharp, the point may easily be rendered very fine. Rec. de la Soc. Polytec.

Observations of Berzelius, on the methods of Paton *and* Marsh *for detecting Arsenic.*

To discover arsenious acid in animal matter, Paton recommends, 1st, to precipitate all these materials from the solution by an infusion of nut galls, and then to decompose the arsenious acid by sulphuretted hydrogen. It is not certain that this method is preferable to that of Tauflieb in which the animal matter is precipitated by a solution of oxide of zinc in caustic potash.

Marsh proposes another method which is worthy of all attention, as it succeeds with extremely small quantities of arsenic.* It is based on the transformation of arsenic into arseniuretted hydrogen, which, according to his statements, takes place very promptly when the suspected mass is acidulated with sulphuric acid, and a piece of zinc added. The hydrogen gas disengaged takes up the arsenic, and Marsh has contrived a very ingenius little apparatus for the experiment, but he manages the gas badly for the purpose in view. He passes it through a fine opening, inflames it, and then receives the flame either on a glass plate, or in a glass tube open at both ends, on which the arsenic is deposited in a metallic state or mixed with arsenious acid.

Marsh has neglected one property of this gas of which we may avail ourselves with much greater certainty, viz. that of depositing its arsenic by heat. Nothing more is necessary than to direct it into a tube heated to redness in one spot; the arsenical hydrogen is decomposed, the arsenic depos-

* See Jour. Frank. Inst. Vol. XVIII, page 336.

ited in the adjacent colder portion of the tube, and the hydrogen gas escapes in a state of purity. For this purpose nothing more is necessary than a common gas bottle, leading the gas, as it issues, through a glass tube, made hot by a spirit lamp. We may, if inclined to greater certainty, put into the red hot part of the tube, a small weighed quantity of copper reduced by hydrogen, white arseniuret of copper is formed, and by re-weighing it, we may estimate with the greatest exactness the weight of arsenic which accompanied the hydrogen.

I dissolved a millegramme of white arsenic in a little dilute sulphuric acid, and added above 6 ounces of water and some zinc. The hydrogen was passed over a little weighed copper, previously reduced by hydrogen and heated to redness in a narrow glass tube. The presence of the arsenic was very evident; the anterior portion of the copper became silvery white, and heated by the blow pipe it diffused a strong odour of arsenic. Having made the experiment with a centigramme of arsenious acid, I obtained about two-thirds of the arsenic which it contained, combined with the copper. This process, admitting it not to answer for a quantitative, deserves our entire confidence in a qualitative analysis and in its application to every case of medical jurisprudence. Jour. de Pharmacie.

To dye Wool and Goat's Hair a delicate blue.

M. Buisson, apothecary, has communicated to the Royal Society of Agriculture at Lyons a new and very simple process. The colour is strong enough to resist water, the sun, and even soap, while that obtained by dye woods fades much more easily, and is very inferior in brightness in an artificial light.

To obtain this colour as pure, fresh and deep as possible, the water of the bath while cold must be first saturated with chrystallized verdigrease (acetate of copper.) then slightly acidulated with acetic or pyroligneous acid; dip the stuffs in the usual way, then wash and dry them.

Jour. de Conn. Usuelles.

Composition of a Varnish for common Candles intended as a substitute for wax candles.

Take equal parts of the balm of benzoin and resin mastic: put each of them in a separate vessel of glass or lead, add spirits of wine, and heat them gently till the resinous parts are dissolved. Let each of the solutions remain a while at rest and then unite them in one vessel.

Prior to using this composition it is advisable that the fluid be heated to 25° or 30° Cent. (= 80 or 90 Fah.) Dip the candle in it from 5 to 10 seconds, then dry it carefully, which will take about 10 minutes. The proportion of the ingredients may vary, but in proportion as the benzoin is diminished and the mastic increased, the candles becomes more liable to soften by handling. If the benzoin be increased, the candle dries too soon and loses its polish and colour. The quantity of alcohol will vary according to the thickness of the coat to be given to the candle. Ibid.

Protest.

M. Pistrucci, who holds a station in the mint at London, is announced as the inventor of a process for striking a matrix with a punch which has never

seen touched by the graver, and which gives, nevertheless, a medal identically the same as the original model in wax. In this operation, the beauty and perfection of the design are at a single blow transferred to the metal whether of gold, silver or copper.

"The process is this: The model being given in wax, earth, wood, or any other convenient material, take a mould of it in plaster, when the mould is dry or oiled: to harden it, take an impression of it in the moulding sand for cast iron, as fine as possible in order that the points may be sharp, and that the materials may become as hard as tempered steel. The back is to be dressed to a plain surface. This piece solidly fixed in a piece of steel, becomes the matrix on which may be struck, either the medal itself, or a punch if it be desired to multiply steel matrices of the medal. M. Pistrucci has tried his process on medals three inches in diameter and with perfect success. The importance of such a discovery is very obvious. Not only medals, but many pieces of jewelery which require to be chased, may be treated in the same manner."

Permit me to say, Mr. Editor, that this important discovery, as you may be easily convinced, is two years and a half old. At that epoch I made known at the Royal Mint in Paris, all that M. Pistrucci has just done in London. A plan of the apparatus and the details of the operation were deposited by me in the Royal Mint, to be placed at the disposal of my fellow labourers in France. They are in the cabinet of the director of the mint.

Since that time the medal engravers have employed my process, and more than thirty medals of the reign of Napoleon have been thus re-produced. You may easily, Mr. Editor, obtain a proof of my statement on application at the Mint.

Caqué, Engraver in the Gallery of the Kings of France,
Royal Mint, Paris.

Jour. de Conn. Us. et Prat.

Method of cleaning Glass.

Reduce to very fine powder a piece of indigo, moisten a rag, apply it to the powder and smear the glass with it. Wipe it well with a dry cloth.

Very finely sifted ashes applied in the same manner by a rag dipt in brandy or spirits of wine will answer well; but spanish white ought to be rejected as it is apt to take off the polish of the glass. Ibid.

Progress of Physical Science.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE, BY J. GRISCOM.

On the part which the Soil acts in the process of Vegetation. Memoir read at the Academy of Sciences, by J. Pelletier.

The ground is the support and nurse of plants; in its bosom, by means of roots, they seek for and find a portion of their nourishment. But to this truth, so simple and obvious, are attached questions of a complicated nature, and of the highest interest to Physiology and Agriculture. With one, among others, I have been particularly arrested, and it has been the object of my meditations. Before I enter upon it, permit me to bring into view some facts which appear to be necessary to the discussion of it.

The earth is not an elementary substance. Its exterior bed, the residence of plants, is formed of various metallic oxides, silica, alumina, lime, to which are often joined magnesia and the oxide of iron. It contains, moreover, the detritus of organic matters which had before possessed life and existence. Thus constituted, and under the influence of air, water and imponderable fluids, the earth is eminently fit for the development of germs deposited in its bosom, and to the growth of the vegetables which flourish upon it.

The necessity of the presence of organic matter, to constitute a soil, endowed in the highest degree with vegetative force, cannot be considered doubtful. In vain did Tull, in 1773, attempt to maintain that distinct earthy particles formed the sole nourishment of the plant. This theory was overturned by the positive experiments of Duhamel, who had at first embraced it. Nevertheless, if it is certain that the presence of organic matter is a condition of fertility, we may still ask whether it is so *essential* a condition—such a *sine qua non*—that a plant cannot vegetate in a soil totally deprived of organic matter, particularly if other circumstances, such as the presence of water and carbonic acid, be united with it.

Numerous experiments have been made to resolve this question. Many of them are contradictory. The greater portion, from the high interest which they involve, ought to be discussed and repeated with care. But another question not less important, and which I think ought to be first ascertained, is this: *What influence have soils themselves in the act of vegetation?* To this question I at present confine myself.

A vegetable soil, in its normal state, must be considered a mixture of various earths, that is, of metallic oxides.

Every soil devoted to Agriculture, is, in general, says Chaptal, formed of a mixture of silica, lime and alumina, and in support of this assertion he cites various analyses.*

Davy confirms this statement in his Agricultural Chemistry, and in fact,

* A very fertile soil in Sweden was found by Bergman to consist of:

Coarse Silex,	30	56
Silica,	26	
Alumina,		14
Carbonate of Lime,		30
		100

A fertile soil in Middlesex gave Davy—Siliceous Sand 3-5; the remaining 2-5 consisted of

Carbonate of Lime,	28
Silica,	32
Alumina,	39

Analysis of a fertile soil in Touraine:

Sand,	49
Silica,	16
Alumina,	10
Carbonate of Lime,	25
	100

A very fertile compost, formed by Tillet consisted of clay 3-8, pulverised lime-stone 3-8, sand 2-8, corresponding to

Coarse Silex,	25
Silica,	21
Alumina,	16.50
Carbonate of Lime,	37.50
	100

not a single instance of a fertile soil has occurred, which consisted of only one earth, or even of two, such as lime and silex, silex and alumina, allumina and lime.

In another passage in his *Chimie Agricole*, Chaptal expresses himself thus: "A mixture of lime, silex and alumina forms the basis of a good soil; but that it may possess all the desirable qualities of good land these ingredients must exist in certain proportions, which analyses of the best soil can only establish.

If we consult the analyses of the most fertile soils, we find that fertility diminishes in proportion to the predominance of either of these principal earths, and that it becomes almost null when the mixture has the properties of only one of them."

Complexity of composition is therefore, in general, a condition of fertility in a vegetable soil. The loose earth which we find in vallies arising from the decomposition of primitive rocks, makes generally an excellent soil. Now, we know that granite, composed of quartz, feldspar and mica, and frequently amphibole, must yield by its decomposition, a soil containing silica, lime, alumina, and a little magnesia and sometimes potash. Soils, originating on the contrary, from the decomposition of more simple rocks, siliceous limestone, for example, are lighter, and suitable only for a limited number of plants; they require, says Chaptal, to be enriched, and are valuable only in moist climates. Land originating in the decomposition of trap, basalt and other rocks of complicated elements, possesses, on the contrary, great natural fertility.

"Rivers," he further adds, "receive in their courses other streams whose mud is mingled with its own, and it often happens that the united sediment of two rivers possesses greater fertility than that of either separately."

This then appears to be an established fact, that a soil, (independently of organic matter) is the more fertile as its composition is more heterogeneous.

If we seek for an explanation of this fact, we find in authors only vague opinions and doubts; the greater number merely state the facts without attempting an explanation.

Agricultural chemists, who indulge more in theory, appear to regard the cause of fertility as dependent on the physical character of the soil rather than on its chemical constitution. Thus Davy having observed that different soils attract moisture with different degrees of energy, and having discovered, as he believed, that the most hygrometric soils were the most fertile, he ascribes their superior fertility chiefly to this property. But Davy has not proved that the hygrometric force of a soil bears any given relation to its composition.

If this attraction for moisture were the principal cause of fertility (abating the influence of manures) we perceive no necessity for the combination of the three earths in the constitution of a soil of the first quality. Indeed a certain quantity of alumina in a soil otherwise entirely siliceous, or entirely calcareous, a certain proportion between the adhesive and the loose or sandy portions, would be sufficient to confer this hygroscopic quality, and of course the fertility of the soil. But we have nothing to confirm this supposition.

The hygroscopic quality of a ternary soil may then be considered as an *element* of fertility, but only a secondary element, subordinate to its chemical composition.

The property of becoming more or less heated by the rays of the sun, which appeared to Davy to hold a relation to the fertility of different soils, appears to me to be also a secondary cause. In the cases referred to by him there was a mixture of black mould, and he did not sufficiently consider its fertilizing action as a manure upon the soil.

To me, it appears evident that the mixture of the various earths which compose a soil, acts upon vegetation and determines its fertility *by an electro-chemical force*, whose action has been clearly recognised in other circumstances, but not yet brought into view in the case now under consideration. In the first place, let us observe that it is a fact, though the truth may have escaped observers, or rather, it has not yet been brought under a formula, that the silica, alumina and lime which enter into a good vegetable soil, must not be combined with each other, but simply mixed, the lime being in the state of a carbonate. A triple silicate of lime or alumina, in which the silex, lime and alumina should be in the proportions which constitute the best arable land, could not, even if thoroughly divided, furnish a soil essentially adapted to vegetation. If in a fertile soil, composed of a mixture of lime, alumina and silica, a combination between these three oxides should begin to take place, the ground would become cold and sterile. Now, it is certain that in a mixture of these three ingredients, a force does exist which tends to combine them. The silica and alumina are, in relation to the lime, electro-negative bodies, and in their presence the lime must acquire a contrary electricity. According as external or mechanical movements of the soil, or other foreign causes, shall bring these molecules within greater or less distances from each other, and group them in various ways, electrical piles will be established, discharges will take place, producing various tensions, and the earth will thus, if we may use the term, become animated. The electric fluid which pervades it will excite the stomata of the radical fibrils, determine the play of the organs, and the absorption of the fluids requisite to the nourishment of the plant. The radical fibrils, and the capillary roots impregnated with moisture, will become so many electrical conductors, engaged in transmitting electricity, certainly as necessary to life as light and caloric.

The merit of a theory is that it accounts for observed facts, enables us to foresee what will take place under particular circumstances likely to happen, and indicates the considerations which it may be desirable to bring about with a view to useful results.

Let us enquire whether the theory now presented fulfils these conditions:

Suppose a chalky soil. To improve it we add argillaceous marl; i. e. to the lime which predominates we add silica and alumina. *To the positive element which we found alone; we add the negative elements which we found deficient.*

Will it here be said that "chalk is so compact that the roots cannot penetrate it, or so split up that water passes through it like a riddle, and that the marling is simply designed to change this physical condition.*

But, if the object was merely to divide the chalk, in order to change its physical condition, a calcareous sand would accomplish this object, and yet it never came into the head of an agriculturist to improve his chalk by limestone, while Gordan de Saint-Memin produced a magnificent vegetation by a mixture of chalk with heath sand.

In a piece of ground belonging to Chaptal, the soil was clayey and rather barren; below was a layer of black earth. Chaptal went to work emphirically, dug up the ground and mixed the two beds together. Contrary to his expectations, the sterility was increased. It was not till the fifth year that the ground acquired a common degree of fertility, that is, when all the iron had passed to the state of peroxide, and the land, black as it was, had

* G. Dict. d'Agriculture, article *Craie.*

become of a deep, bright yellow. Chaptal asks, if in this case the black oxide is injurious to vegetation, either by itself, or in reference to the oxygen.

In our theory the fact explains itself, and might have been foreseen:—the black oxides of iron (fer oxidule' d' Haüy) is a combination of protoxide and sesquioxide of iron, a substance *indifferent* in relation to silica and alumina. Exposed to the air the combination is destroyed, the iron passes to the state of peroxide, susceptible of union with silica and alumina. Yet, under such circumstances it was not worth while to mingle the two beds, since five years were lost in attaining a common degree of fertility.

The theory which we have adopted is applicable likewise, in the happiest manner, to the operation called marling. Marl is not a simple mixture of silica and alumina with more or less of carbonate of lime. Its base is argillaceous and calcareous silicates; some mineralogists consider it even as an oryctognosaical species.* It is on this account that plants cannot vegetate in marl which has not been long exposed to the air, even when the silica, alumina and lime are in the proportions which form good arable land. By exposure to the air, carbonic acid *destroys the combination* which existed between the earths, and it is then, and then only that marl will enrich the soil. In this case, if the negative element prevails, as in the case of argillaceous marls, it becomes excellent for calcareous soils; and marls called calcareous are in their turn advantageous for argillo-sandy land.

It has been remarked that the alkaline and earthy salts, which, in a certain quantity, injure vegetation, produce a good effect when employed in small doses. Chemists and farmers have sought to explain this action of saline compounds. Some have thought that certain salts were good for plants, as some are for animals,—that salts, and even earths, formed part of the food of vegetables; others, on the contrary, that they act principally as stimulants to vegetation. Without denying that earthy substances may enter into the constitution of a vegetable, to unite and give strength to the parts that are to support the organs, like phosphate of lime in the bones of quadrupeds, I may remark, that with a few exceptions, the presence of any salt is not absolutely necessary to vegetation. Thus, for example, borage and lettuce, whose extracts contain much nitre when they grow in highly manured soils, do not contain any sensible portion of it when cultivated without dung. I therefore, rather incline to the opinion of Physiologists, who think with M. Decandolle, that salts act as excitants or stimulants. But, what is the meaning of excitation? At the present day, science no longer admits of those vague explanations which consist of nothing but words. I understand by excitation, the eminent property of conducting electricity which salts communicate to water. It is in this manner, as it appears to me, that nitrate of potash acts, in the prodigious energy which it gives to vegetation. It is probably in this way that sulphate of lime acts—that is to say, by rendering the water a better conductor, though in this case the effects appear to me to be complicated, and to be worthy of direct experiment.

Thus far, for greater simplicity, we have considered lime as free, in speaking of the mixture of silica, alumina, and lime, which constitute a soil: now the lime is in the state of carbonate, but it does not in that state cease to be an electro-positive element in relation to silica and alumina. This circumstance allows us to explain an important vegeto-physiological fact.

* Brochant's Mineralogy.

The carbon in vegetables is produced mostly, if not entirely, by the decomposition of the carbonic acid which they absorb not only from the air, but from the ground: such is the opinion of the celebrated Decandolle. This carbonic acid, furnished by the ground, appears to enter into the vegetable at the moment of its liberation, probably dissolved in the water which the soil contains. It is absorbed by the spongioles of the radicules; it ascends with the sap, urged forward as by a *vis á tergo*. But how is this carbonic acid produced? In certain manured soils, and in superficial portions of the earth, penetrated by the air, we may conceive it to be formed by the re-action of oxygen upon the carbon of organic detritus; but at those great depths which are attained by the roots of oaks and cedars of a hundred years old, how can the carbonic acid be developed? How can the oxygen and organic matter penetrate to such depths? In our theory there is no difficulty. Carbonic acid comes from the lime, on which the silica and alumina act slowly but continuously to form silicates.*

Thus then, at certain depths, and under influences but little understood, silica would decompose carbonate of lime, while at the sùrface of the earth, and under the influence of exterior agents, the silicates would be decomposed by carbonic acid produced by the re-action of the oxygen of the air on organic detritus,—an admirable and providential rotation, which re-establishes the equilibrium, and incessantly tends to the rejuvenescence of nature.

The last corollary of my theory,—the decomposition of silicates by exterior agents, and particularly by carbonic acid, cannot be called in question. It has been established by M. Becquerel, under circumstances in which the force of cohesion might seem to present a serious obstacle. I allude to the decomposition of the feldspar of granite, and the formation of kaolin. The analogy is here so strong that I must render the homage of my first conception to the distinguished academician I have just cited.

The fact of the decomposition of carbonate of lime by silica in the interior of the earth is equally supported by experiment and observation. And first, if, in proceeding to the analysis of a vegetable soil, when the coarser siliceous sand has been separated by agitation and deposition, and the carbonate of lime has been removed by weak acids, we examine the finer terrene substance which has resisted the weak acids, we find that it is not alumina, as Chaptal indicates, nor silica, as is stated in various works, but that it consists principally of veritable silicates of lime, of alumina, and of oxide of iron.

Still, it may be objected that these silicates are anterior to all vegetation; that to prove their recent formation and daily production, requires direct experiments. These direct experiments are among the objects which I wish to undertake. They require much time. But to prove truth, are we to depend solely upon new experiments peculiar to him who advocates it, and are we forbidden to rely on the labours of our predecessors? Certainly not. I may therefore again refer to the interesting researches of M. Becquerel, and bring into view those mineral species which he has formed in his laboratory, and which present all the characters of their natural congeners.

* Animal manures may contribute to the decomposition of silicates, not only by the carbonic acid which they form by absorbing oxygen from the air, but in producing such substances as the *fat acids*, which have a tendency to unite with lime and to eliminate the silica which is combined with it. M. Raspail, whose talents we are glad to acknowledge, without sharing in all his scientific opinions, appears to us to have explained the siliceous petrefactions that are found in chalk, in a very happy manner by the action of animals entombed in siliceo-calcareous beds. (Physiol. Vegetate t. 2. p. 339.)

Neither can I omit to mention the important fact of the artificial formation of feldspar by Cagnard de Latour.

There is still another objection which may be made to the theory now presented. If in this mixed state, the earth acts by virtue of electro-chemical forces, why are three earths requisite to the construction of a good soil? Ought not silica and lime, or lime and alumina to be sufficient to produce, in each element of the mixture, an opposite electricity? It is easy to answer this objection also, by a reliance upon facts well known to mineralogists: it is certain that the binary silicates are more rare in nature than the ternary silicates, and that their mass in particular is less powerful: silica has therefore a greater tendency to combine with lime and alumina together than with either of these earths separately. Hence we may perceive that the union of the three becomes necessary to constitute a soil endowed with the highest degree of vegetative power.

If the ideas which I now submit to the Academy appear to deserve any attention, I propose, on the return of the favorable season to renew the enquiry, and to devote myself to the labour of positive experiment,—experiments, which, whatever may be their results in reference to my theory, will at least have the advantage of eliciting facts which may be friendly to agriculture, that science which is so prominently stamped with the character of utility.

Jour. de Pharmacie.

Indications of Organic remains in the oldest Rocks of the Globe; means of distinguishing Trap from Basalt; By Henry Braconnot.

The author examined some specimens of Trap from the neighbourhood of Essey, in the south of the department of La Meurthe, a region which had been considered by some naturalists as volcanic, although neither crater, lava nor scoria was to be found in it. Some prisms of blackish basalt are indeed obtained there, but it is well known, he remarks, that certain traps are found under geological conditions which forbid all idea of volcanic action. This pseudo-primitive form is due to the shrinking which the rock undergoes in drying. To determine whether these prisms from Essey had undergone the action of fire, he resolved to compare them with true volcanic basalt. He subjected to distillation, in a small glass retort, some of the Essey basalt, pulverized, and obtained from it an empyreumatic, ammoniacal product, which restored the blue colour of paper reddened by tournesol. The residuum of the distillation had a deeper shade than before, so that the carbon seemed to have been more exposed. Various other genuine traps from different places were in like manner powdered and distilled, and furnished absolutely the same product as the first.

From these facts he infers, that all these enormous masses of Trap which are found in the chain of the Vosges and in other places, have been formed in water under the influence of moderate temperature, and that prior to their formation the remains of organized beings were intimately mingled with the other elements of which they are constituted.

He next examined true basalt, which had incontestibly undergone the action of subterranean fire. A portion from Clermont in Auvergne was heated to redness in a glass tube closed at one end, and in which a strip of paper reddened by litmus was placed. Instead of changing to blue, as had been the case with the traps, no change took place; which shews that the organic substance which may be presumed to have existed among the materials of basalt before its formation, was destroyed by the volcanic fire.

By this test the author thinks volcanic basalts may be easily distinguished from traps, and that it may put an end to the discussions which still divide geologists, and banish the confusion which prevails in the determination of the rocks called *Basaltes.*

This unexpected discovery of animal matter in trap rocks, regarded by some geologists as contemporaneous with granite, induced him to examine that also. Some ancient granite, enclosing porphyroidal eurite was heated nearly to redness in a glass tube with reddened litmus paper, which very soon changed to blue. A slight odour appeared which was somewhat empyreumatic, though much less decided than in the case of the traps. Another specimen of ancient granite gave a similar result, and Egyptian sienite from the collection of M. Haldat yielded an ammoniacal odour on distillation.

"I conclude from these facts, that rocks regarded as forming the centre of the terrestrial globe, or at least as the nucleus of primitive mountains, include vestiges of organic remains, and that, however their formation may be explained, it has not taken place at a high temperature. I have also examined in the same way, several ancient rocks nearly contemporary, such as green porphyry and serpentine, which, like granite, gave a product scarcely empyreumatic and restored the blue of tournesol. Some granitoid amphibole from Tillot, (Vosges,) yielded an aqueous ammoniacal product of an odour decidedly empyreumatic, which seemed to indicate a formation less ancient than granite. Gneiss from Mybury, in Saxony, gave an acid which acted on the retort, apparently fluoric acid.

Some spotted sand-stone from Vosges, collected at the surface of the ground, furnished no signs of organic matter. Further extension might be given to these enquiries, but the facts here stated appear to me sufficient to change, or modify, our different hypothesis of the origin of rocks and the state of the globe at the epoch of their formation. Ann. de Chem. et de Phys.

Changes of Temperature which our Globe has undergone; by M. L. Agassiz.

In a very interesting discourse on the Glaciers Moraines, and erratic Blocks of the Swiss Mountains, delivered at the opening of the Helvetic Natural History Society, at Neuchatel, on the 24th of July, 1837, by its President, M. L. Agassiz, an account is given of the phenomena of the changes produced by the agency of Glaciers in remote periods, especially on the southern slopes of the Jura; to account for which the celebrated author adopts a theory of temperature quite new, it is believed, in Geology, notwithstanding the fertility which has characterised the opinions of those who have written upon this subject within a century or two past.

It is well known to those who have visited the Alpine regions that the Glaciers, or immense bodies of ice, which fill up more or less of the intervening space between the ridges that exist on the sides of the mountains, push along in their descent masses of stones and rubbish which collect on their sides like winrows, and which are known by the name of *Moraines.*

But it is not so well known that ancient *Moraines* are to be seen at various successive heights, both upon the Jura and the Alps, forming walls which follow the sinuosities of the sides of the valleys. Many stages of them are seen, some of which are some hundreds of feet above the bottom of the upper valleys of the Alps, where Glaciers now no longer exist.

Some there are which are quite distinct at a height of two thousand feet above the valley of the Rhone, above its entrance into the lake of Geneva.

A striking phenomenon also is the polished appearance of the surface of the rocks over which these ancient Glaciers have passed, evidently produced by the abrasion of the stones and gravel which have been urged along by them. Traces of these former Moraines may be followed even to the margin of the lake of Geneva. Whole sides of the valley of the Rhone are thus polished to the very shores of the lake, evidently produced by great masses of ice, which in former times have filled the bottom of all the Alpine valleys. Their polished surfaces, (denominated *laves* by the mountaineers,) are formed on the southern slope of the Jura, which fronts the Alps, to its very summit.

Moraines are witnessed on the very margin of the lake of Geneva, and on both banks, at the same elevation, rendering it certain, according to Agassiz, that there was a time when the lake was frozen to the bottom, and when the ice was elevated to a considerable height above its present level.

On the southern slope of the Jura are also large blocks or boulders of Granite which must have come from the Alps, some of which are of the size of 50,000 cubic feet. These are usually less rounded and are even of a larger size than those which are found in the Moraines at the margin of the existing Glaciers. These large angular blocks repose on small blocks, or pebbles, rounded by attrition and these again rest upon smaller, which pass below even into a fine sand, lying immediately over the polished surfaces of the Jura rocks.

The removal, or transportation, of such boulders has been very generally attributed to vast currents of water, or to floating ice. But the insufficiency of this theory appears very evident from the order of superposition, which is constantly opposed to all idea of a transport by currents. To account satisfactorily for the existence at once of these ancient *Moraines*, of the unpolished surface of the sides of the valleys, and of the order of superposition, is the great object in question. I must give the theory of President Agassiz in his own words, as I find it in a translation of his discourse in *Jameson's Edinburgh New Philosophical Journal.* G.

I shall now proceed to that explanation of the phenomena which I consider the most plausible; and which is the result of my own views, together with those of M. Schimper, upon the subject. In glancing at many general questions which are connected with the explanation, I have no intention of expatiating upon them. I wish simply to demonstrate that the subject now before us has a relation to the most interesting and important geological inquiries.

The study of fossils has for some time led to very unexpected results, especially since it has assumed a physiological character; that is to say, since it has been recognised, that a progressive development exists in the whole range of those organized beings which have formerly peopled the earth; and since epochs of renewal have been recognised throughout the whole. Those individuals who have admitted this progression ought not now to entertain any fears in prosecuting these consequences to their legitimate limits; and the idea of a uniform and constant diminution of the earth's temperature, such as is now sometimes admitted, is so contrary to every physiological idea, that it must be strenuously repelled, to make way for another, viz. that there has been a diminution of tem-

perature, which has been accidental in relation to the development of the organized beings that have appeared and disappeared one after the other at determinate epochs, maintaining itself at a particular mean temperature during a giving era, and diminishing at certain fixed epochs.

As the development of individual life is always accompanied with that of heat, since its continuance establishes a certain equilibrium of longer or shorter duration, and since its extinction produces an icy coldness, I conceive I deduce only legitimate inferences, when I conclude that the same phenomena occurred upon the globe: that the earth, when it was formed, acquired a certain very elevated temperature, which progressively diminished during the different geological formations; that during the continuance of each of them, the temperature has not been more variable than that of our globe since it has been occupied by its present inhabitants, but that it has been at the epochs of the disappearance of these inhabitants that a fall in the temperature has taken place, and that this fall has been beneath the temperature which prevailed in the subsequent epoch, and which re-appeared with the development of the newly animated creatures which were called into existence.

If this theory be correct, and the facility with which it explains so many phenomena which have hitherto been deemed inexplicable, induces me to believe that it is, then it must follow that there has been, at the epoch which preceded the elevation of the Alps and the appearance of the existing animated world, a fall of temperature far below that which prevails in our days. It is to this fall of temperature that we must attribute the formation of those immense masses of ice, which must universally have covered the surface, where we find these erratic blocks along with rocks which are polished as are ours. It is also, unquestionably, this extreme cold which has enveloped the Siberian mammoths in ice, has congealed all our lakes, and accumulated the ice as high as the ridges of our Jura, which existed before the elevation of the Alps.

This accumulation of ice above all the hydrographic basins of Switzerland may easily be supposed, on reflecting that when lakes are once frozen to the level of their emerging current, the running waters no longer drain off, and those of the atmosphere, augmented by the vapours of the southern regions, which under the circumstances, abundantly precipitate themselves towards the north, must have most rapidly augmented the extent, and raised the level even to the height which has already been established by the foregoing facts. The winter of Siberia was for a time established upon a soil previously covered with luxuriant vegetation, and peopled with great Mammalia, whose fellows in our day inhabit the warm regions of India and Africa. Death enveloped nature in its winding-sheet, and the cold reaching its extremest limit, gave to this mass of ice, at the maximum of tension, the greatest hardness it could acquire. When any one has frequently witnessed the congelation of a lake, he can then form a conception of the vast resistance of ice in this condition, and to what immense distances hard bodies which are thrown upon its surface may glide in consequence of even a feeble impulse.

The appearance of the Alps, the result of the greatest convulsion which has modified the surface of our globe, found its surface covered with ice, at least from the North Pole to the shores of the Mediterranean and Caspian Seas. This upheaving, by raising, breaking, and cleaving in a thousand ways, the rocks which compose the prodigious mass that now forms the Alps, at the same time necessarily raised the ice which

covered them; and the debris detached from so many deep upbreakings and ruptures, naturally spreading themselves over the inclined surface of the mass of ice which had been supported by them, slid along the declivity to the spots where they were arrested, without being worn or rounded, since they experienced no friction against each other, and even when arrested came in contact with a surface so smooth; or after being stopped, they were conveyed to the margin, or to the clefts of this immense sheet of ice, by that action and those movements which characterise congealed water when it is subjected to changes of temperature, in the same manner as the blocks of rock which fall upon the glaciers, approach their edges in consequence of the continual movements which the ice experiences, in alternately melting and congealing at the different hours of the day and seasons of the year. These effects ought to be described in detail; but as they are partly known I shall not dwell upon them.* I shall only remark, that the power of the action, so far as the ice is concerned, is immense; for these masses, continually moving upon each other, and on the surface, bruise and grind down every thing movable, and polish the solid surfaces on which they repose; at the same time that they push before them all that they encounter, with a force which is irresistible. It is to these movements we must attribute the strange superposition of rolled pebbles, and of sand which immediately repose upon the polished surfaces; and it is unquestionably to the grating of this sand upon these surfaces that the fine lines which we find are owing, and which would never have existed if the sands had been acted upon by a current of water; for neither our torrents, nor the stormy waters of our lakes, produce any thing like this upon the very same rocks. As to the longitudinal direction of these fine lines, and of the furrows which are observed upon the polished surfaces, it ought to be observed that they must have resulted from the much greater facility which the ice had in dilating itself in the direction of the great Swiss valley, than transversely, confined as it was between the Jura and the Alps; the phenomenon itself commencing only with the retreat of the ice, at the time that the Alps appeared. I have not the slightest doubt that the greater number of the phenomena which have been attributed to vast diluvial currents, and in particular those which M. Seefstrom has recently made known, have been produced by ice.

Upon the elevation of the Alps, the surface of the earth would be reheated, and the caloric disengaged on every side would produce the melting of the ice, which would gradually retire into its present domain. Clefts would first be formed in those places where the ice was thinnest, that is to say, on the summits of the mountains and the hills which were covered by it, afterwards upon the most saliant parts of the plain; valleys of drainage would then be excavated at the bottom of these clefts, in localities where no current of water could flow without being inclosed within congealed walls; and when the ice had completely disappeared, the great angular blocks which had covered its surface, or had fallen into the clefts, would be found upon a bed of small rounded pebbels, under which is usually found a layer of sand. In melting from the surface, the ice must necessarily have continued longest in the depressions of the country, in the little longitudinal valleys which are formed by the dif-

* M. Schimper has written a most interesting work upon the effects of ice, to which I should have been most happy to refer if it had been published.

ferent zones of the strata of the Jura, and at the bottom of the lakes; and it is undoubtedly to this circumstance we are to attribute the extraordinary position occupied by so many of these blocks, which are perched up, scarcely in equilibrium, upon the highest points of rocks; and also their constant absence in the hollows, where they are not found, except, at least, where fresh momentary expansions of the ice were able to precipitate them.

So long as the level of the ice on the Jura had not fallen below the line of Pierre-à-Bot, the blocks which were yet spread over its whole surface, might continue their descent towards the Jura; but so soon as the ice became thin over the plain of Switzerland, it must have very speedily disappeared, and have only left portions in the deep valleys, and in the basins of the lakes, that is to say, it must have been soon confined to the lower valleys of the Alps.

In reflecting upon what must necessarily have occurred upon this disappearance of the ice, we are naturally led to think that the transport of the rolled pebbles of the valley of the Rhine, and the deposition of *Löss*, must have been among its first effects; and this is confirmed by the facts, that these pebbles are the same with those which we found along with our blocks, and that the *Löss* is evidently the result of the detritus of the *molasse*. The frequent *dèbâcles* of the ice could only at that time convey blocks upon the masses of ice to great distances, or carry them farther in their current.

The melting and maceration of the ice and its repeated congelation in cold weather have produced many other geological effects, which it is difficult to account for as produced by any other causes. Without again recurring to the valleys of drainage or erosion, I may mention those deep furrows which are not fissures, and which have above them plains of great extent; also those small lakes which are sometimes formed near the edges of the glaciers, and which so affect the small stones that are accumulated at their margins, as to impress upon them the appearance of stratification; or again, the analogous phenomena which are observed upon the limits of different stations where the immense sheets of ice have successively stopped in their retreat; and likewise the dispersion of the bones of the Mammalia at the diluvian epoch, without their being at all rolled or broken, and in short, a number of other particulars which have no interest except when we embrace the whole of the question.

From this moment the surface of the earth must have been afresh subjected to the influence of the regular succession of the season. Then appeared the first spring time of the animals and plants which flourish in our days. The ice had retired to the foot of the Alps, and from their summits it began to receive fresh reinforcements. Speedily it reached its last retreats, where it is ever oscillating, sometimes gaining in extent, and forcing the blocks before it, and sometimes again retiring within narrower and narrower limits. At each step of ground they abandoned they left behind them, as the existing retreating glaciers now do, some of those long dykes of blocks which still exist in the Alpine valleys. Soon, too, the lakes themselves would melt, the waters would assume their present courses, the valleys of the Alps would be drained, and there remained no more ice, the product of former congelation, except on the summits of snow-clad mountains.

It would be a great mistake, therefore, to confound the glaciers which descend from the summits of the Alps with the phenomena of the epoch of that extensive ice which had preceded their existence.

The phenomena of the dispersion of erratic blocks, then, ought not any longer to be regarded in any other light than as one of the circumstances which have accompanied the vast changes occasioned by the fall of the temperatures of our globe previous to the commencement of our epoch.

The admission of an epoch of cold, which was so intense as to cover the earth to such distances from the pole with so vast a mass of ice as we have been contemplating, is a supposition which appears in direct contradiction with those well known facts, which shew a considerable cooling of the earth since the most remote period. Nothing, however, has proved that this refrigeration has been constant, and that it has occurred without oscillations. On the contrary, whoever has been in the habit of studying nature in a physiological point of view, will be much more disposed to admit that the temperature of the earth has been maintained, without any considerable oscillations, to a certain degree, during the whole period of any geological epoch, as is occurring in our own epoch, since it has diminished suddenly and considerably at the termination of each epoch, a change accompanied by the disappearance of the organized beings which characterized it, that it may rise again with the appearance of a new creation at the commencement of the following epoch, although at a lower degree of mean temperature than the preceding one, so that the diminution of the temperature of the globe may be expressed by the following line:—

Thus, the epoch of extreme cold which preceded the present creation, has only been a passing oscillation of the temperature of the globe, somewhat more considerable than the periodic refrigeration to which the valleys of our Alps are subject. It was attended by the disappearance of the animals of the diluvian epoch of geologists, as the mammoths of Siberia still attest, and preceded the uprising of the Alps, and the appearance of the animated nature of our day, as is proved by the moraines, and the presence of fish in our lakes. There was thus a complete separation between the existing creation and those which have preceded it; and, if the living species sometimes resemble in our apprehension those which are hid in the bowels of the earth, it nevertheless cannot be affirmed that they have regularly descended from them in the way of primogeniture, or, what is the same thing, that they are identical species.

By prosecuting these views, we may anticipate that the time will come when we shall be able to determine the geological period at which the sun began to exercise an influence upon the surface of the globe, so considerable as to produce the differences which now exist between the different zones, without these effects being neutralized by the influence of the internal heat, from which the earth must for a time have enjoyed a very uniform temperature over all its surface.

This theory, I fear, will not be adopted by a number of our geologists, who have settled and confirmed opinions on the point; but I anticipate it will be with this question, as with many others which assail old and established views. At all events, whatever opposition it may experience, it will remain true that the numerous new facts relating to the transport of blocks which I have pointed out, and which may be studied so easily in the valley of the Rhone and the environs of Neuchatel, have brought the discussion into wholly different ground from that on which it has hitherto been debated.

When M. de Buch for the first time affirmed, in opposition to the formidable school of Werner, that granite is of Plutonic origin, and that the mountains had been uplifted, what did the Neptunist say? At first he sustained his position alone; and it has only been by his defending it with the innate powers of genius, that he has made it triumph. It is happy for us, that in scientific discussion, numerical majorities at first have never decided any question.

The form into which I have thrown these observations will, I trust, banish all discussion on the subject at the present moment; and as, at the same time, I cannot hope that I have convinced every one of the truth of my views who have heard them for the first time, I propose the Geological Section as the most suitable for any discussion which may follow. I shall then make it my business to meet any objections which may be started; and, for the sake of truth, I earnestly solicit them.

Edin. N. Philos. Jour.

New Experiments on Light.

M. Arago read a note addressed to the Academy by M. Soliel, Jr., the object of which was to lay his claim to undoubted priority in all that relates to the construction of chromatic apparatus, intended to exhibit on a large scale the experiments of polarized rays of light through crystalline laminæ. For many years past, those philosophers who have paid particular attention to the optics of polarization, and among whom we will mention Messrs. Barbinet, Delezenne, Pelcet, Pouillet and Nœremberg, who have given their advice to this able artist, who has himself introduced many useful modifications in the arrangement of these experiments, which are so brilliant, and yet so little known. We ourselves can testify to the magnificent effects produced by these apparatus.

Last week, notwithstanding the inconvenience occasioned by the sun shining very dimly, Professor Pouillet exhibited these beautiful phenommena to the immense audience that is attracted to his course of natural philosophy. By the aid of this apparatus, which is both simple and reasonable in price, fifteen hundred persons were enabled to see and admire the system of admirable fringes produced by the interference of rays, an experiment attributed to Fresnel, and which is but a very happy modification of the colored rings of that master of all natural philosophers, Sir Isaac Newton.

The instruments of M. Soliel are equally adapted to the demonstration of the laws of double refraction, and of their identity with luminous polarization. By interposing crystalline laminæ in the path of rays, polarized by tourmaline, it exhibits on a large scale the brilliant complementary colours discovered in this case by M. Arago. This same crowd of spectators enjoyed the sight of the surprising results shown by crystals with one or two axes, which throw on a white screen, systems either circular, hyperbolic, or lemnisbates, curves tinted with a thousand colours, and of a brilliancy which no other process can even approach. Thus, all these magnificent images, obtained in France by Fresnel, Biot and Arago, and in England by Brewster, Herschel and Airy, are no longer cabinet phenomena, but may be exhibited to the most numerous assemblages.

We will add, that M. Soliel, jr., is not only the first who has made at Paris these beautiful apparatus, but he has discovered a very curious

effect produced by the dilatation of carbonate of lead on its optical axes and their superb curves. But these are things that must be seen to be appreciated, and all the descriptions in the world cannot give the slightest idea of the dazzling phenomenon of polarized optics.

We have been informed that our much esteemed fellow citizen, Professor A. D. Bache, was present at the experiment alluded to. Several specimens of M. Soleil's workmanship have been sent to this country, affording ample evidence of his ability, and we understand that Mr. Dobson, No. 108, Chesnut street, has received, and will continue to receive, orders for the apparatus made by him. Poulson's (Phil.) Daily Adv.

Progress of Civil Engineering.

On the comparative strength of the Cylindrical Tubes employed in high-pressure Boilers; with a plain practical rule for determining the relative strength of such tubes,—being in reply to a question of Mr. J. Hall in his letter to Mr. J. Seaward, of the 4th July, 1838.

To W. J. Hall, Esq.

(Copy.) Canal Ironworks, Limehouse, August 22nd, 1838.

Sir,—In your letter to me of the 4th July last, there was one question which I did not answer, viz., that respecting the difference of strength of plates employed in the construction of tubes: the reason of my not then replying to that question was, that it would have led into too much detail to be conveniently introduced in the then pending inquiry; the subject, however, being important, I now send you what I hope will be a satisfactory reply to your question. I also send you a few observations respecting the idea that steam boiler accidents are attributable to the explosion of gases. I propose to publish these documents, to which I presume, you can now have no objection.

I am, Sir, yours most obediently,

(Signed) John Seaward.

The strength of a cylindrical tube to resist an external pressure exerted on its outward surface, is a very different thing from the strength of the same tube to resist an internal pressure.

In the latter case, that is, when the force is exerted on the inside of the tube, and tending to burst or rend it asunder, the relative strength or power of resistance of the tube is very easily estimated; it is well known to be, under like circumstances, in the simple ratio of the thickness of the metal of which the tube is formed, and *inversely* as the diameter of the tube.

But in the other case, when the pressure is external, the strength of the tube to resist such pressure will depend upon very different principles:—it is generally supposed that the strength of a cylindrical tube under such circumstances must be immeasurably great; and there is no doubt that such is really the fact, provided the pressure is uniform all round the tube, and that the true cylindrical figure is strictly preserved; because in such case the tube is like a well-formed arch; it cannot be

destroyed except by the absolute crushing of the particles of metal one into the other, which is altogether improbable. But if the true cylindrical or circular figure is not preserved, and indeed if the deviation from the true figure of greatest resistance is ever so trifling, the principle of the arch is gone at once, it is then like an arch without abutments; and the tube under such circumstances, instead of being able to resist almost infinite pressure, will in fact be unable to resist a comparatively moderate pressure.

Now, practically speaking, it is almost impossible to form a tube that shall* be strictly cylindrical, or of any other figure of greatest resistance; the very weight of the material is sufficient of itself to destroy the true figure; the circumstance of the tubes of steam boilers being formed of metal plates with lap joints riveted together precludes the possibility of obtaining the true figure; moreover, in the case of horizontal tubes, as they are employed in steam boilers, the pressure is not uniform; for while the pressure on the upper part of a tube six feet in diameter may be only 13½ lbs. upon the square inch, the pressure on the lower part of the tube will be nearly 16½ lbs. to the square inch, because the weight of a column of water six feet high, has to be added to the pressure on the lower part of the tube; therefore the cylindrical, or circular, form is not in that case the true figure of greatest resistance; and it is not very likely that in the ordinary way of the business of boiler making, much care or correctness can or will be bestowed to the calculating, or afterwards in the making, of the tube, agreeably to the true figure of greatest resistance.

Moreover, if all the above difficulties be overcome, and the tube is formed according to the true figure of greatest resistance, there is little chance that it will long remain so, in the practical working of a boiler; the unequal contraction and expansion of the plates by being partially overheated and then suddenly cooled, accidents of constant occurrence, will cause the plates to be drawn and buckled, and thereby soon destroy the true figure. And it should be borne in mind that however trifling the alterations of form may be at first, yet the moment a slight alteration has taken place, the destructive change then goes on at an accelerated ratio. And here a very important distinction should be observed, which is, that when the force is exerted within a tube tending to burst it outwards, the force exerted will not induce any change of form such as to render the tube weaker; because if the tube was originally made tolerably near to the true figure of resistance, any change of figure which may afterwards take place, must be such as will render it in fact stronger—that is, supposing the metal plates to have some degree of elasticity—it will cause the tube to assume the figure of greatest resistance. But, it is not the same with a tube that supports an external pressure, because in this case, any change of figure must, demonstrably, produce a greater departure from the figure of greatest resistance, and thereby render the tube weaker and weaker; and this is a very important reason why a tube that has

* As a strong corroboration of this fact it may be stated that about fifteen years back some interesting experiments were made to ascertain the relative force which copper tubes were able to support internally and externally; the tubes were beautifully made, and as perfectly cylindrical as hands could form them, but it was found in every case that a much less force was sufficient to crush or collapse the tube than was required to burst it asunder.

been proved to a pressure of 30 or 40 lbs. to the square inch, may afterwards fail under a pressure of less than half that amount.

For the above reasons it is therefore clear, that a practical estimate of either the absolute or relative strength of tubes, supporting an external pressure, cannot be based upon the idea of these tubes being correctly formed agreeably to the figure of greatest resistance; the safe mode is to estimate the strength of the tubes by the capacity of the metal plates (of which the tubes are formed) to resist a transverse strain, in the same manner as we should estimate the strength of a flat plate, a bar, or a beam, the strength of which is known to be in the ratio of the square of the thickness or depth, in the direction of this strain.

Under this view of the matter, therefore, it would be correct to consider, that the strength of tubes under an external pressure would vary as the *square* of the thickness of the metal, but it is also clear that the strength will also vary *inversely* as the *square* of the diameter of the tube; because an increase of diameter not only increases the leverage, but also the absolute quantity of force in a like ratio.

But it would not be right to suppose that the absolute strength of curved plates in a tube is no greater than that of perfectly flat plates; this is not the case: there can be no question that the curved form enables the plates to sustain a much greater force than flat plates are able to support; and it is clear that the nearer the curvature of the plates approximates to the figure of greatest resistance, the greater force they will be able to bear; for although, as is stated above, the slightest deviation from the figure of greatest resistance destroys the principle of the arch, and thereby reduces the comparative strength of such tubes from almost infinity to a strength of very moderate limits, nevertheless curved plates will support a greater or less strain the nearer or the more remotely they approach to the true figure of greatest resistance.

It is therefore evident, that besides the capacity of resisting a transverse strain, there is another element of strength in tubes subject to external pressure; that is, the strength derived from the curvature of the plates; but, as this latter strength depends entirely upon the greater or less approximation of the curvature to the figure of greatest resistance, and as the degree of approximation will vary in every individual case, and will also be liable to rapid alteration in the same tube, it is clear that no general rule can be given for determining the strength thereby gained. And, indeed, this is not requisite in the present instance, because it is not intended to offer a rule for estimating the positive strength of tubes, but simply the relative strength of different tubes; which, as above stated, is, in like circumstances, as the square of the thickness of metal, and inversely as the square of the diameter of the tube. The positive or absolute strength of such a tube can only be known by actual proof, but this once known by the strength of other tubes may be estimated by the following rule :—thus, if a tube of 3 feet diameter and made of ½ inch plate is capable of sustaining a given external pressure, what will be the relative strength of a tube 6 feet diameter made of ¼ inch plate? Answer—the former is 16 times stronger than the latter.

But, in the case of the force acting inside the tube with a tendency to burst or rend it asunder, the strength of the tube will be as the thickness of the metal directly, and inversely as the diameter; therefore, if a tube is 3 feet diameter, and made of ½ inch plate, it will be 4 times as strong as a tube of 6 feet diameter made of ¼ inch plate.

The foregoing is a safe, easy, practical rule, and if employed by boiler makers in the planning of high-pressure boilers, I believe it will be the means of preventing many serious errors and fatal accidents.

Limehouse, August 20, 1838. JOHN SEAWARD.

Mech. Mag.

On the Cornish Engines. By THOMAS WICKSTEED, M. Inst. C. E.

In this communication, Mr. Wicksteed gives an account of several trials which he made on some engines in Cornwall. In a trial of the engine upon the Holmbush Mines, the water was delivered into a cistern and weighed, and the result obtained by an experiment was 102,721,323 lbs. raised one foot high with ninety-four pounds of coal: this was the quantity raised and delivered. The quantity raised does not, however, express the duty of the engine, which must be calculated according to the contents of the pumps and the atmospheric column, without any allowance for leakage. According to this calculation, the duty would be nearly 118 millions; namely, 117,906,962 lbs. raised one foot high with ninety-four pounds of coal.

Another calculation is then given, founded on the law of Boyle, that the pressure of the steam is inversely as the space occupied. The steam was cut off at one-sixth of the stroke, and the temperature in the jacket was fully maintained by free communication with the boiler. The mean pressure of the steam being (on the above law) 17.66 lbs. on the square inch, the power of steam would be 271,658,700 lbs. Now, as the duty would be 117,906,992, we have 93,751,710 for the friction of the machinery, or about 7½ lbs. per square inch; which is about two pounds more than the friction of a water works pumping engine.

Mr. Wicksteed also made trial of a double engine at the Tincroft Mines working stamps, cutting off the down-stroke at two-fifths, and in the up-stroke at one-third. The duty of this engine was 56,525,072.

The coals consumed by the Tincroft engines amounted only to 1.57 lbs. per horse power per hour; whereas, in an experiment at Oldford, the quantity was 4.82 lbs. notwithstanding the additional friction in the former case of the mining engine. The consumption is stated by Mr. Farey, in his Treatise on the Steam-engine, for a double engine (Boulton and Watt,) at 10½ lbs. per horse power per hour.

At the end of the paper are two tables, the one showing the gradual improvement of the steam-engine during sixty-six years, and the other the average duty of engines in Cornwall, for 1835 and 1836. The improvement has been progressive from 1769 up to the present time; and it appears, on the authority of Mr. John Taylor, that on comparing the water raised and the coals consumed from 1799 to 1828, at different times, there is a saving on the books of the mines proportionate to the improvements stated to have been made during these periods in the working of the engine.

Some discussion took place on the weight of the bushel of coals, Mr. Lowe stating that he had never known a bushel of Newcastle coals to weigh more than 84 lbs. Mr. Price stated, that the Welsh coal, which was chiefly used in Cornwall, was very heavy, and he had known a heaped up bushel to weigh 101 lbs. The weight of the Newcastle coals was considered as varying from 80 to 84 lbs. *Jour. Arts & Sci.*

Camus on the Teeth of Wheels.

May 4th, 1768, died Charles Stephen Lewis Camus, the celebrated French geometrician, aged 69; author of a well-known Treatise on the teeth of Wheels, in which the best forms to be given to them for the purpose of machinery, were for the first time determined, on true mathematical principles. An English translation of this treatise appeared in 1806, with some additions from the translator's own pen, which evinced an unfortunate ignorance of the scope of M. Camus' demonstrations; and have been a fruitful source of error in English mechanical practice. Camus proved clearly that the epicycloidal part of a tooth, designed to act on another wheel or pinion, ought to be generated by a circle equal to *the radius* of the wheel or pinion with which it is to be engaged; while his English translator represented his meaning to be, that it should be equal to *the diameter!* Mr. J. I. Hawkins, who has lately favoured the public with a more correct edition of the treatise, states, that "many of our first-rate engine manufacturers" have been so misled by this misconception of the original translator of Camus, that they are daily "pouring into the market multitudes of cast-iron wheels and pinions, of various magnitudes, for cotton and other machinery, with teeth formed from the epicycloid of the diameter, instead of the radius of the opposite wheel, or pinion," and which must, in consequence, "wear out in a few years, instead of lasting the greater part of a century,—as many of them would do, if the teeth were formed on true principles. We regret to learn, from the same authority, that there are many wheel-makers who follow no rule of proportion at all in their formation. "In Lancashire, they make the teeth of watch-wheels of what is called the bay-leaf pattern; they are formed altogether by the eye of the workman, and they would stare at you for a simpleton, to hear you talk about the epicycloidal curve. These Lancashire workmen should be called the bay-leaf fanciers, because they cannot be bay-leaf copiers; since it is notorious that there are not two bay-leaves of the same figure. It is the opinion of Mr. Hawkins, that teeth accurately formed, either by epicycloid or involute curve, will endure the wear of a century, with less damage than teeth, as usually made, suffer in ten years.—*Mechanic's Almanac.*

Mech. Mag.

An account of an immense Chimney, recently built at Carlisle; with Suggestions for applying Chimneys, or Cones, of immense Height, to scientific purposes. By P. A.

"The immense chimney attached to the new cotton factory, now being built for Messrs. Peter Dixon and Sons, in Shaddongate, had the last stone placed upon it on October 24, 1837. It is one of the highest buildings in England, being 305 ft. from the ground; and for the purpose to which it is to be applied, is understood to be the highest erection in the world. It may be distinctly seen for many miles in all directions around Carlisle, and forms a beautiful object in the view of our city, from which ever quarter you approach it. The building is of the octangular form, and is built with brick, the angles being formed of stone. The base, which is built with fire-bricks, is 17 ft. 8 in. in width inside, and the thickness of the wall at the foundation is 10 ft. It tapers upwards to a width, inside, of 6 ft. 3 in.; and on the outside 8 ft. 9 in. Near the top

there is a cornice of stone, 7 ft. in depth, which projects 3 ft., and above this there are 8 ft. 3 in. of brickwork, surmounted by a coping stone one foot in thickness. The cornice gives a finished and classical appearance to the building; and the whole would be taken for some splendid national monument, rather than a mere conduit pipe for smoke. It is not a little creditable to Carlisle, that this magnificent work was entirely executed by a native of that city, a builder, a Mr. Richard Wright, who has completed it in a way to give the most entire satisfaction to every scientific man who has examined it. Considering its immensity, the work was completed in an incredible short period of time. The foundation stone was laid on Sept. 11, 1835, by P. Dixon, Esq.; the first brick was laid by Mr. Wright, on Sept. 17.; the last course of bricks, also by Mr. Wright, on Oct. 22, and the last coping stone on Oct. 25, 1836; thus completing the work in thirteen months. The erection was carried on from the inside, stages being erected as the work proceeded, and the workmen and materials being taken up in boxes prepared for the purpose, by a crab worked by four men; and it is gratifying to add that the whole was finished without any accident occurring to any individual engaged in it. Agricul. Mag.

Transactions of Institution of Civil Engineers.

June 13, 1837.—The President in the Chair.

Warming and Ventilating.

Mr. Oldham resumed the account of his system of warming and ventilating, and exhibited a model of his stove for heating the air. He was convinced that the expedient of forcing the air by mechanical means must be resorted to. He had raised the temperature of a room 24° F. in one hour; by spontaneous ventilation he could never obtain a temperature of more than 100° F., but by pumping in the warm air he readily obtained a temperature of 150° F., or 180° F.

Light House Lamps.

Mr. Horne called the attention of the Institution to a lamp which he thought would be peculiarly applicable to lighthouses, or wherever an intense light is required. The usual burners are an inch in diameter; now he had succeeded in producing a clear white light by a burner of half an inch in diameter. The excellence of the light is due to the complete combustion obtained, by making the area of the external equal to the area of the internal apertures. The air thus passes directly to the burner; there is a perfect uniformity of draught, the rapidity of which may be regulated by the height at which the burner is above the bottom of the glass, or chimney. The draught of air being thus supplied with perfect equality to both sides of the wick, a flat and steady flame of two inches in height is obtained, and the force of the draught is sufficient to prevent the flame from touching the edge of the burner, so that the edge is always clean and fit for use. Jour. Arts and Sci

Mechanics' Register.

New Material to be applied to Dwelling Houses, to render them capable of resisting Fire.

About the middle of November, 1837, the scientific world was somewhat startled by observing, in the newspapers, an announcement that a discovery had been made and perfected, of a material to be applied to dwelling houses, capable of entirely resisting the action of fire; that an experiment was to be made to prove its efficacy, at White Conduit House, Nov. 25, 1837; and that the presence of all parties concerned was requested to view the exhibition. It might have been supposed that the answer to this appeal would have been universal; and, as parties generally attend where there is nothing to pay, and they really are interested, that half London would have been present on the occasion. But, unfortunately, John Bull has had "Wolf!" shouted to him so often of late, mighty discoveries have turned out "such fantastic tricks," that he has grown very sceptical indeed. There was, however, a tolerably numerous party collected at White Conduit House on the day of experiment; some, of course, interested in its success; others, perhaps, equally so in its downfall. The material is, in appearance, a cement, and, like it, may be applied with the trowel, or with a brush in the manner of paint. Mr. Dewitte, the inventor of this composition, considers that it should be applied to the timber of a house while building, about a quarter of an inch thick; or it may be employed instead of the common plaster now in use, as it can be worked with equal facility, and polished and painted the same. Sufficient quantity has not yet been prepared to form any certain estimate of the expense; but he considers that the cost of preparing the whole of the timbers of an 8 or 10 roomed house would not exceed 30*l.* or 40*l.* For the experiment, two little wooden houses had been constructed; the one prepared interiorly, with the exterior just washed over to show the nature of the composition, and the other left in its natural state. These were filled with shavings and fired: the one not prepared was, of course, immediately one mass of flame; while the other resisted every effort to ignite it. It was delightful, at this moment, to watch the disappointment of the oppositionists, who afterwards took an unfair advantage of a neglect on the part of the proprietors. When the burning mass of the unprepared house was at its greatest heat, they busied themselves to turn it round close upon the other building, though Mr. Dewitte assured them that the exterior of the building was not prepared. After some time it began to burn, and they gloried in their triumph, until the one building, having burnt itself out, dropped to the ground, and discovered the side of the other partially burnt away, but with the inside coating and the rest of the building as perfect and unharmed as if it had never been touched, notwithstanding the furnace heat that had been applied to both sides of it. The persons assembled, among whom were Mr. Barry, and other eminent architects and scientific people, declared themselves perfectly satisfied of the complete success of the material: the only hope expressed was to see the experiment tried on a larger scale, when the proprietors shall be better prepared for it. Convinced of its perfect efficacy and value, I trust they will imme-

diately set about preparing a more extensive trial, to prove to those who are so anxious to throw cold water on the invention, that it is of no more use in stopping their progress, than it would be in stopping the progress of the flames when we shall enjoy the security of having our houses prepared with their composition.—*A. December*, 1837. Arch. Mag.

Discovery of ancient Piece-Goods and manufactured Stuffs.

It is more than a thousand years since Theodolphus, Bishop of Orleans, gave to Notre Dame du Puy en Velay a beautiful manuscript, containing the ancient Testament, the chronography of St. Isidor, and other pieces, the whole distributed into 138 articles. He made this gift in gratitude for his deliverance from the prison of Angers, where he was confined in 835. It was on Palm Sunday that year, while Louis Le Debonnaire was passing, that he began to sing a well-known Canticle, which the Catholic church has since then introduced into its ceremonies. This precious manuscript, in a state of perfect preservation, is to be seen in the archives of the Bishopric of the Puy en Velay, department of the Haute Loire. A portion of the manuscript is written on leaves of common parchment, in letters of red and black, intermixed with some of gold. The other portion is written on leaves of parchment, dyed purple, with letters of gold and silver, among which are observed ornaments of different kinds and different colours, designated the Byzantine style. The manuscript, which is remarkable for its beauty and its preservation, is still more remarkable for the *manufactured stuffs* of different descriptions which it contains. When Theodolphus composed his manuscript, with the intention of preserving the gold and silver characters from contact and friction, which, in time, would have tended to displace and obliterate them, he placed between each page a portion of the manufactured tissues peculiar to the era when he lived. These examples of the silk, and other pieces of goods of the time are thus curiously preserved. Till lately, little attention was paid to these tissues, which are principally of India manufacture, and which bear scarcely any analogy to the products of the modern loom. Some are Cashmere shawls of those patterns, which the French call *broucha* and *espouline*, and made in the Indian fashion, but with this difference, that they are limited to four colours, and demonstrate the greatest antiquity by the primitive simplicity of their colours and design. Others are crapes and gauzes, against the luxury of whose transparent tissues, the fathers of the church at that time so perseveringly fulminated their censures. The rest consist of muslins and china crape of exquisite beauty. The components of the majority of these tissues consist of goats' or camels' hair of exceeding delicacy and fineness. Like the manufactured stuffs of ancient Egypt, painted on the walls of its palaces and tombs, or substantially preserved amidst the envelopes of mummies, the designs are limited to four colours, which are in fact the four sacred colours of China, India, Egypt, and the Hebrew Tabernacle. Nevertheless, the Egyptian designs, which are identical with those of India, are many of them of exquisite beauty. The consummate skill of the silk and cotton manufacturers of ancient Egypt, 4000 years ago, the beauty and richness of their fabrics—and the little alteration which has taken place in the economy or machinery of the factories, as well as in

their product, has been recently demonstrated in the great work of Champollion. All the details of the silk and cotton factories of Egypt, under the Pharoahs of the 18th dynasty (which then monopolised the commerce of the world, and which sent a colony of weavers, from the overburthened population of Lower Egypt, to found Athens, and the subsequent civilization of Europe and this country) are laid open with vivid accuracy in that splendid work, and brought with all their startling analogies before the eye of the modern reader by the drawings from the temples, palaces, and tombs which it contains. It proves, indeed, that there is "nothing new under the sun." Mining Rev.

Probable duration of English Coal Beds.

In the fifth edition of Mr. Bakewell's *Introduction to Geology*, just published, there are some remarks on the duration of English coal, in addition to the observations made in the former editions of the work, which were quoted in evidence given on the subject in a committee of the House of Commons. After noticing the report of the committee, which estimated the annual consumption of coal in Great Britain at twenty-two millions seven hundred thousand tons, Mr. Bakewell proceeds to observe:

"The increasing demand for coal in the iron furnaces, and for steam navigation and steam carriages, will probably soon raise the quantity of coal annually consumed to thirty millions of tons, without adding to this ten millions of tons for coal left and wasted in the mines. A better idea of the consumption of coal will, perhaps, be formed by stating the quantity of coal burned in the furnaces of one house only (Messrs. Guest, of Myrther Tydvil, in Glamorganshire,) which is 970 tons per day, or 300,000 tons yearly; the amount of iron produced is 50,000 tons. This is a larger quantity of iron than was made by all the furnaces of Great Britain and Wales in the year 1760, and exceeds the quantity of iron at present made in Scotland, which in 1827 was only 36,500 tons. Surely when such an immense quantity of coal is required for domestic use and manufactures, it cannot be wise to encourage, or even to admit, the export of coal to foreign parts. The coal so exported, exclusive of that to Ireland and the colonies, is 500,000 tons annually. The duty on exported coal was entirely taken off in 1835, to satisfy the great landed proprietors in the north of England. I have before stated that the coal in Northumberland and Durham would at the present rate of consumption be exhausted in 350 years. An agent of one of the northern proprietors, in his evidence before the House of Commons, extended the duration of the northern coal fields to 1,727 years, estimating that there remained 732 square miles of coal in Northumberland and Durham still unwrought, and that the average thickness of the coal is twelve feet. In this calculation it seems to have been assumed that each workable bed of coal extends under the whole coal field, but many of the best and thickest beds of coal crop out long before they reach the western termination of the coal districts, or are cut off by faults or denudations. Professor Buckland, in his evidence on the subject, estimates the duration of the coal at the present rate of consumption to be 400 years. Professor Sedgwick, who is well acquainted with the coal strata of Northumberland and Durham, and had examined persons of great experi-

ence, gave his opinion respecting the duration of the coal in these counties as follows:—'I am myself convinced that with the present increased and increasing demand for coal, 400 years will leave little more than the name of our best coal seams;' and he further adds, 'our northern coal field will probably be on the wane before 300 years have elapsed.' "

Mr. Bakewell concludes his remarks on this subject by observing that his former anticipations, that improved methods of burning coal would be discovered, have been realised to a great extent; in proof of which he alludes to statements made at the last meeting of the British Association at Liverpool, of the use of the culm or dry coals of South Wales, by employing the hot blast, in smelting ironstone, which coal it had formerly been attempted to use for that purpose without success. "If," continues Mr. Bakewell, "the use of the hot blast is found everywhere to succeed, the consumption of coal in the iron furnaces will be reduced one half. It may, however, be doubted whether this reduction will equal the increasing demand for coal for steam-vessels and rail-road carriages, and the various manufactures of Great Britain." Farmer's Mag.

Steam Coach.

A few days since, Dr. Church's steam-coach went to Coventry with an omnibus attached to it, loaded with passengers, at the rate of twelve miles per hour. It ran up the hills at the rate of eight miles an hour. It came back with twenty-three passengers (three ladies,) without any accident. On Friday it proceeded to Meriden and back, also with an omnibus and passengers, and without accident. It will go to a more distant town early this week.—*Birmingham Gaz.*

On the Adulteration of Carmine; by C. G. Ehrenberg.

There occurs in commerce a kind of very fine coloured and very expensive carmine in the form of cakes, which owes its fine colour to an adulteration. Upon being made use of for ordinary painting no difference has been observed, but by the microscope it may be discovered that half of it consists of starch (wheat starch) which imparts to the finely divided carmine a clear ground and a brilliancy highly improving the appearance of the colour. When such carmine is mixed with much water, it diffuses itself throughout, and is for a long time suspended; but upon pouring off the water a white sediment remains similar to white lead. The sediment is starch. Besides this distinct form and size of an amilaceous body, when it is examined by its reaction upon tincture of sodium, it produces the well-known blue colour. This sediment when heated with water forms a paste. The addition of white lead is detected by its weight, but the addition of starch is not so easily discovered; but by means of the microscope the adulteration may be with certainty recognised, and confirmed by chemical examination. It may perhaps be interesting to the artist to know that few colours of this description mixed without an organic body, although pretty generally permanent, that are not in a damp atmosphere very liable to decomposition. In regard to its covering properties, starch differs considerably from white lead. It covers less on account of its transparency.—*Poggendorff's Annlaen, No.* 12, 1837.

Lond. & Edin. Philos. Mag.

Pin-making.—Triumph of Machinery.

At Messrs. D. F. Taylor and Co's patent solid-headed pin manufactory, near Stroud, the machinery simultaneously performs the various functions, with little noise or effort while converting the rings of wire into pins, without the instrumentality of any manual assistance whatever; for while one combination of the machine is drawing forward, and straightening the wire, and cutting it to the required length, another apparatus is forming and smoothing the point, a third compressing and shaping the head, and a fourth detaching and drawing out the pin in its finished state, which falls into a receiver prepared for it; thus forty-five pins per minute are made by machines, while the whole plant is producing the almost incredible number of three millions two hundred thousand pins daily, exceeding nineteen millions weekly throughout the year.

Mining Jour.

Number of Patents in France.

It appears, from authentic documents, that the following number o patents for inventions and improvements was granted in France from the 1st of July, 1791, the period at which they were first accorded, to the 1st of January in this year. The account is divided into the following periods:—During the Constitutional Monarchy, which lasted but three years, 67 patents were granted; during the Republic (fourteen years) 301; during the Empire (eight years) 606; during the Restoration, (sixteen years) 3383; during the Monarchy of July (seven years) 3018; total during the whole period 7375.

Ibid.

Raising a large Stone in the River Tay.

An immense stone, long supposed to be a rock, and imbedded in the fairway of the channel, the top of it being immersed to the depth of five feet at low water, has been lately removed from its situation by operations continued during only five tides. The stone, of which the solid contents were 598 cubic feet, and the weight between forty and fifty tons, was raised by means of two dredging lighters, capable of containing twenty-five tons each, which were brought to the spot at low water. A hole of two inches diameter was previously made in each side of the stone, and plug-bats having been inserted, a chain was fastened to them, and thus when the tide rose, the stone was floated off its bed and conveyed ashore.

Ibid.

Preserving Scythes, &c., from Rust.

To preserve scythes, sickles, reaping hooks, and other steel tools from rust after the season for using them, wipe them clean and dry, and hold them before the fire and keep drawing them backwards and forwards until warm enough to melt wax; then take some bees' wax and rub it all over. A halfpenny worth of wax will be sufficient for a scythe. Then put it in a dry place, but not warm; it needs no other covering. The usual method is to wrap a hay-band round; but in winter time this naturally contracts moisture, or the damp air strikes in betwixt the folds of the hay-band.

Farmer's Mag

LUNAR OCCULTATIONS FOR PHILADELPHIA, JANUARY 1839.					Angles reckoned to the right or westward round the circle, as seen in an inverting telescope. ☞ For direct vision add 180° ☜	
Day.	H'r.	Min.	Star's name.	Mag.	from Moon's North point.	from Moon's Vertex.
21	6	20	Im. π Piscium	6	70°	90°
21	7	3	Em.		1	32
26	8	12	Im. 49 c Aurigæ	6	79	24
26	9	34	Em.		279	253
26	11	18	N. App. ☽ & 54 Aurigæ 6, ☽ S. 1.'9			
27	13	46	Im. c Gem.	6	117	174
27	14	31	Em.		197	256
28	16	10	Im. γ Cancri	5	28	84
28	17	2	Em.		276	331
30	8	19	Im. 34 Leonis	6	21	329
30	9	5	Em.		293	241

Meteorological Observations for July, 1838.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	70	80	29.80	29.85	E S W.	Moderate.	.2	Cloudy—showery.
	2	70	85	86	90	S.W.	do.		Cloudy—lightly cloudy.
	3	72	88	85	63	W.	do.		Clear—do.
	4	70	90	80	80	S.W.	do.		Clear—do.
	5	74	91	80	80	S.W.	do.		Foggy—clear.
	6	72	83	90	90	N.W.	Brisk.		Clear—do.
○	7	66	88	90	90	W.	Moderate.		Clear—do.
	8	71	89	90	90	W.	do.		Clear—do.
	9	74	92	86	86	W.	do.		Clear—do.
	10	78	94	80	86	W.	do.		Clear—do.
	11	78	92	75	75	W.	do.		Clear—flying clouds.
	12	74	85	75	80	N.W.	do.	.20	Clear—rain.
	13	64	78	90	30.00	N.E.	do.		Cloudy—clear.
☽	14	68	85	30.15	15	W.	do.		Clear—flying clouds.
	15	66	86	.05	00	S.W.	do.		Clear—do.
	16	68	88	29.85	29.80	S.W.	do.		Clear—do.
	17	74	86	85	85	W.	do.		Clear—do.
	18	71	87	95	95	S E.S.	do.	.39	Flying clouds—rain.
	19	74	86	85	80	W.	do.		Clear—lightly cloudy.
	20	76	92	85	80	W.S.W.	do.		Flying clouds—do.
⊗	21	79	87	70	70	W.N.W.	do.		Flying clouds—do.
	22	63	75	90	90	N N.E.	do.		Flying clouds—do.
	23	60	78	30.00	30.00	S W.	Calm.		Clear—flying clouds.
	24	61	77	00	00	S.W.	do.		Cloudy—do.
	25	67	84	29.80	29.80	S.W.	do.		Flying clouds—do.
	26	69	84	80	80	N.N.W.	do.	.48	Cloudy—fly. cl'ds.—rain in n'gt.
	27	74	88	85	85	S.W.	do.		Clear—do.
	28	72	93	90	90	W.	do.		Cloudy—do.
☾	29	77	92	88	8[illegible]	W.	Brisk.		Clear—do.
	30	75	92	70	70	W.	Calm.		Clear—do.
	31	60	84	80	80	W.	do.		Clear—flying clouds.
	Mean	70 52	86.42	29.86	29.86			1.09	

	Thermometer.	Barometer.
Maximum height during the month.	94. on 10th.	30.15 on 14th.
Minimum " " "	60. on 23d and 31st.	29.63 on 3d.
Mean	78.47	29 86

JOURNAL

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MECHANICS' REGISTER.

DECEMBER, 1838.

Progress of Practical and Theoretical Mechanics and Chemistry.

Remarks on some prevailing misconceptions concerning the Actions of Machines. By Edward Sang, Esq.*

In this paper I proceed to expose the fallacy of some prevailing notions concerning the actions of machines in general.

The fancy that machines are capable of generating power, though fostered by a very absurd proclamation from our government, is now almost entirely abandoned; and, except from two or three individuals ignorant of the history and of the principles of mechanics, we hear of no attempts at obtaining the reward offered for the perpetual motion. But another fancy differing less from this than it at first appears to do, is very generally entertained. We are perpetually told of the loss of force which arises from the obliquity of the actions of machines, and are called upon to examine cumbrous and expensive contrivances for rendering these actions direct, and for regaining, or even more than regaining, the force that has been wasted. If any arrangement of machinery were capable of destroying force, putting friction out of view, the inverse action of the same machinery would be capable of generating it.

The truth is, that every machine, however ill contrived, and however il constructed, delivers over the whole, and exactly the whole. amount of force which put it in motion. Part of that force is expended in overcoming the friction of the rubbing surfaces, and in encountering the resistance of the air, while the rest goes to produce the particular effect which the contriver of the instrument may have had in view.

The geometric contrivance of machines, the arrangement of the parts so as to produce particular motions, has unlimited scope. But in a mechanical point of view, the inventor can, profitably, direct his attention only to two objects—economy in the material and labour necessary to the first con

* Read before the Society of Arts for Scotland, 9th January, 1833.

struction of the instrument, and the diminution, as far as is practicable, of the effects of friction. Were all friction avoided, it would be a matter of absolute indifference by what means the required changes of motion might be produced; it would then be of no moment whether we employed the reciprocating or the rotary steam-engine,—whether we used the crank, or the sun-and-planet wheel,—farther than the mere expense of workmanship is concerned. And we have no other criterion for estimating the superiority of one contrivance over another than the comparisons of the amounts of friction in the two cases.

These statements will be startling enough to persons half acquainted with the nature of machinery. "What," they will ask, "does the obliquity of the crank cause no loss of force? Is there no force wasted in producing the reciprocating motion of the beam in the steam-engine? And were they mere dreams that we entertained of immense improvements in machinery?" And when I assert, what is well known to every one acquainted with the subject, that there is no loss of force from the oblique action of the crank, that there is no force wasted on the reciprocating motion of the beam, and that the removal of friction is the only source of improvement in machines for transferring power,—I oppose the prejudices of multitudes who ought to be better acquainted with the principles of mechanics.

The principles which regulate the balance of pressures, and the movements of bodies, though discovered by man, are not of human invention; they are laws impressed by the Omnipotent upon the material world—laws to which matter yields an implicit, a perfect obedience. These laws are few in number, and the simplest language in which they can be expressed involves the very statements I have made. To exhibit, then, the truth of these statements would be to examine the reality of the fundamental laws of mechanics. To this examination I will not proceed, but will content myself with founding my investigations on the more common forms in which these laws are recognised. They naturally divide themselves into two classes: those which relate to the pressures of the acting parts during any momentary state of the machine, and those which relate to the properties of the machine considered as in motion. Those of the first, or statical, class, though at first sight very numerous, are summed up in one law, called the *principle of virtual velocities*. My first object will be to exhibit this principle in a clear light; not, indeed, as I would do in a scientific treatise on the subject, but in such a manner as appears to me to be best fitted for removing those prejudices, the existence of which has occasioned this paper.

When two weights balance each other by means of the wheel and axle, it is well known that they are to each other inversely as the diameters; but if the machine be turned a little round, the distances through which the weights move are directly as the same diameters,—so that, if each weight be combined with the distance through which it moves, the two results are exactly equal to each other. The descent of one pound through ten inches would, for example, be accompanied by an ascent of ten pounds through one inch, and thus whatever is gained or lost in intensity of pressure, as much is lost or gained in distance. It will be readily seen that the same thing is true of the straight lever, and of those combinations of pulleys which have their strings parallel: but in the case of the *inclined plane*, of the *bent-lever*, and, in general, of all machines in which the relations of the pressures are altered by a change in the position of the instrument, the application of the same rule is not so easy; and the slight difficulty that attends it has elicited the assertion, that the principle of virtual velocities is there at fault.

The relative motions of the different parts of a machine can easily be deduced from its geometric properties. The principle of virtual velocities enables us, from these motions, to compute the forces, and thus connects the geometric with the mechanical properties of machinery. This principle, one of the most beautiful and most pervading in nature, may be thus expressed :—

If the position of any machine be slightly disturbed, and if each pressure which has yielded, be combined with the distance through which it has yielded, and each pressure which has advanced, with the distance through which it has advanced, the sum of the one set of results will be exactly equal to the sum of the other set.

Now, in the case of the inclined plane, says the objector to the reality of this law, the weight raised and the weight which raises it move over equal distances. The motion of the weight is here mistaken for the distance through which its gravitation is overcome; its absolute motion, for its motion in altitude: now, it is well known that the force requisite to drag a body up an inclined plane, is to the weight of that body as the height of the plane is to its length; and therefore the principle of virtual velocity is here adhered to. This misconception is palpable and easily corrected; the motion of the machine does not alter the proportions of the forces. But, in the case of the bent lever, the error must be more involved, since it has crept from the work-shop to the lecture-room, and has been promulgated where sound knowledge and accurate ideas ought to have rewarded the labours of the student. The arcs, we are told, which the ends of the arms describe, are proportional to the lengths of these arms, while the balancing forces are not proportional, inversely, to the same lengths. Here, again, the absolute motion of the point of attachment is mistaken for the distance through which the pressure is overcome. If, however, the objector's capacity be not entirely exhausted by the immense profundity of this remark, he will reply, and with justice too, that even estimating the motions in the directions in which the pressures act, the rule does not hold good.

For the removal of this mighty difficulty I must summon all my strength. Accustomed to handle tools (I speak not for myself only, but for every devotee of true philosophy), accustomed to handle tools admirably adapted for facilitating researches of this nature, and now called upon by the circumstances of the case to lay these tools aside and to venture on the question with unappareled hands, I cannot altogether divest myself of repugnance to the task. To render it, however, more inviting, I shall make the question as general as possible, and without confining myself to this, or any other, individual case, apply my remarks to those machines generally, in which the forces vary with the positions of the parts.

Conceive that for a given position of such a machine, the pressures are so arranged as to balance each other, and then let the machine suffer a displacement. If this displacement be considerable, the equilibrium will be materially disturbed, and the estimate of the motions, far from giving information concerning the original forces, would commingle the means for determining the forces in all positions between the first and last, and would rather be the basis for determining the conditions of the mean state, than of either of the extreme ones. However small may be the displacement, still will there exist an error in the estimate; yet the more minute the displacement, the more inconsiderable will be the error, because there will exist the less difference between the two extreme states of the machine. In order, then, to compute the pressures accurately, we must determine the

proportions which subsist between the motions of the parts, supposing that these motions are infinitely small. I know of no other method for effecting these computations than that contained in the Differential Calculus, or in the more abstruse but more satisfactory theory of Lagrange; and, although the name of fluxions be a bug-bear to thousands, it is absolutely impossible without its aid, to advance beyond the threshold of mechanical investigation. The advocates for mental indolence may urge that the statical properties of many machines may be examined without the aid of the fluxional calculus. Such is, indeed, the case, and these machines and such methods of calculating concerning them may afford lessons to the beginner; but from such processes few, if any, general conclusions can be drawn, while the instant that motion is contemplated, all these resources fail.

The principle of virtual velocities, such as I have defined it, holds true of all machines, even though subjected to the retarding influence of friction; and is applicable not merely during a momentary state, but also to the motions of machines. Denoting by the word *force*, the result of the combination of a pressure with the distance through which it acts; if the sum of the accelerating forces be just equal to that of the retarding ones, the quantity of motion in the machine will be unaltered, but if the two sums be unequal, then will the speed be changed. Now, in almost all machines the forces and velocities are subjected to periodic variations; the method then of computing the change in velocity consequent upon a change of force must be clearly understood, ere we obtain any information as to the general properties of machines in motion.

The great proposition which connects the statical with the phoronomic properties of machines is this; that the change in the entire quantity of motion is proportional to the difference between the separate amounts of the accelerating and of the retarding forces; the quantity of motion being estimated by combining each moving mass with the second power of the number which represents its velocity. Now, I have already said, that whatever be the nature of a machine for communicating force, the amount of force delivered during a minute instant of time at the one end, is exactly equal (throwing out of view the friction and the weights of its parts) to that communicated during the same instant to the other end; so that the same change is produced in the entire quantity of motion, whether the force be applied directly to the moving mass, or whether it act upon it through the intervention of machinery. This most important principle I shall endeavour to illustrate by example.

Borrowing my illustration from the steam-engine, I shall suppose one in which the piston acts directly upon the fly-wheel, by means, say of a double rack working alternately on each side of a toothed wheel. Here it will not be denied that the accession to the quantity of motion in the machine during a half-stroke will be exactly what is due to the agency of the pressure of the steam upon the piston through the whole length of the cylinder, less, of course, by all the amount of all the retarding forces during the same period. Contrast this with what happens in the common steam-engine. Let the connecting rod be so nearly in a line with the crank, that a pressure of one hundred pounds on the piston exerts only a pressure of one pound in the direction of rotation; then does it follow, from the principle of virtual velocities, that if the piston advance minutely in the cylinder, the extremity of the crank will advance one hundred times as far along its path. The quantity of motion generated in the machine then will be what is due to a pressure of one pound acting through one hundred times the advance of

the piston, or, what is the same thing, to the pressure of one hundred pounds acting through that advance itself. The same thing is true for every other minute motion of the piston, and, therefore, the whole amount of motion communicated to the machine through the crank is exactly equal to that communicated to it by means of the double rack and toothed wheel, or by means of any other contrivance whatever.

In the two arrangements, however, which I have contrasted, the motion will be divided among the parts in very different proportions. The manner of that distribution vitally affects the economy of the machine. The entire quantity of motion is not and cannot be concentrated in the fly-wheel; the piston and all the other moving parts must have their share of it. In the engine with the double rack, the piston and its appendages possess, from the beginning of a half-stroke until the end of it, their full velocity. During the half-stroke, therefore, none of the force of the steam is expended in generating the motion of the piston; but just when the piston has reached its extreme position, its whole velocity must be extinguished and generated in the opposite direction, and the consequence is, that the extreme tooth of the rack will receive a blow as if from a hammer as heavy as the piston and all its appendages, and moving with twice its velocity; and although no loss of force would arise from this action, its continued repetition would tear the machine to pieces. In the case of the balanced crank-engine, on the other hand, during the first part of a half-stroke, the velocity of the piston and beam is gradually increasing; at the middle their velocity is the greatest; and during the latter part it gradually decreases. In the first quarter revolution of the crank, the force of the steam is thus partly expended in producing the motions of the piston, beam, and connecting rod; but in the second quadrant, when these motions are being retarded, the force necessary to accomplish this retardation communicates an equal accession of motion to the fly-wheel. Still, then, is the whole force of the steam expended in overcoming the friction, and in producing the particular effect which may be wanted; still is there no force lost on account of the obliquity of the actions, or of the reciprocation of the movements; and still is the diminution of the friction the only source whence increased effectiveness can be obtained.

I do not expect that what I have just said will be sufficient to eradicate misconceptions so prolific of crude and abortive schemes. The failure itself of the contrivance is often inadequate to convince its inventor of the fallacy of his ideas. Fortified in his ignorance by the fancy that theory is a different thing from practice, there is small chance of his yielding to the arguments of one whom he considers as a pure theorist. The fashion of the day, which puts diffuse and indistinct notions in the place of true learning, which cries for science leveled to the meanest capacity, or as I would translate it, to the most confirmed indolence, fastens these prejudices more firmly on the minds of the half instructed. Were the evils of this fashion to rest with those who turn to philosophy for relief from the ennui of idleness, they might have been passed over in silence; but when they reach that class to whose usefulness extensive information is essential, their removal becomes an object of the highest importance. It would not be proper for me, in the present paper, to venture into the depths of this subject; but the connexion between what is called *popular science* and many of those mistakes which are so current, is too immediate to permit of remarking on these without casting a glance, at least, to their fertile source.

Were the laws which regulate the phenomena of the universe, laws of

human invention, and did they involve contradictions and absurdities, then, indeed, with some propriety might the cry be raised, "They are too abstruse, they are too difficult; let us have them simplified and leveled to the meanest capacity." Level these laws, and they are no longer the laws of nature; the true method of seizing them, is to nerve the mind with higher powers; to infuse into it an exalted ambition, and to come to the attempt prepared for long-continued and strenuous exertion. Would effeminacy pave the way to the white summit of the Jungfrau? or, had your parlour hearthstones been brought from the summit of Ben-Lomond, think you that your delighted eyes could thence have wandered over lakes and mountains? No. He who would scan the wonders of Nature, who would contemplate the wisdom, the beneficence of her works, and would use his acquirements for the advantage of his race, must give himself enthusiastically to the pursuit, and must scorn to turn from the difficulties in his path. Perseverance will crown his exertions with success; and the elevation of his mind, the calm and ineffable delight which accompanies the acquisition of knowledge, will, a thousand times, repay all his exertions. From the throne of science he will descry connexions and arrangements and sympathies among the passing events, and turning, with his colleagues, to the yet unscaled heights, he will emulously pursue the career of discovery. The present is a spirit-stirring time; on all hands have discoverers been at work; from north and south has the hitherto unpassed barrier been assailed, and already have the signals of the workmen on either side been descried by their fellow-labourers. Elated by the prospect of speedy success, they now redouble their exertions, and expect ere long to re-assemble on a higher platform. The science of mechanics has long reared its head proudly over its fellows. Under its efficient guidance, its indefatigable votaries have estimated the weights and motions of the heavenly bodies, and carried into the highest department of the science an exactness almost superhuman. Now, however, the sciences of chemistry, galvanism, and magnetism, advance rapidly to take their stations by its side, and promise to rescue from the charge of inconsistency the great laws of mechanics.

The precision which reason assigns to mechanical phenomena, the precision which these phenomena exhibit when the planets, launched in unfilled space, perform their mighty evolutions, fails us, when we lower our contemplations to terrestrial objects. Here the perfection of nature seems to be marred, the traces of absolute exactitude to be effaced, as if some evil genius had thwarted the Almighty in his design, and sowed confusion where order was intended. All motions on the surface of the earth are soon extinguished, and there was no wonder that men, in the infancy of science, drew the conclusion that matter possessed a reluctancy to move. It required a mind of no common energy to burst the shackles which education and early experience had combined to rivet, and to oppose its solitary strength to the bigotry of false religion and false philosophy. Unaided, Galileo long maintained the contest, and although at last the man fell, his doctrine was victorious. Since that time friction has been recognized as the antagonist principle, which opposes, and invariably succeeds in extinguishing, motion, which creates errors in the results, and uncertainty in the practice of mechanical operations. Far, however, from being the cause of the imperfection of machines, friction is essential to their very existence. Not a fastening would be secure, not a screw would hold were it not for its pervading agency. Without friction this world would have exhibited a scene of indescribable confusion. Conceive for a moment, its influence suspended, and

where would be progressive motion? how would we climb the steep, how, even, would we walk along the plain? The mountain masses, rushing to the plains, and not arrested even there, as now, but hastening along with undiminished speed, would leave no spot for vegetable, no safety for animal life: though dashed to powder by repeated blows, each particle would yet move onward, and chaos would be realized. Far, then, from friction marring the general design, it, itself, is one of the most admirable and most beneficent provisions which nature's God has made for the felicity of his creatures.

When we glance over the vast fields of modern science, and contemplate the harmony that reigns among the known laws, when we consider the ease with which geometry is engrafted on arithmetic, the perfect acquaintance with geometric laws which is exhibited in the contrivance of the mechanical ones, we cannot imagine that the law of friction militates against or annuls one really existing law of nature. Chemistry has acquainted us with the permanency and indestructibility of matter; mechanics has taught us that the entire amount of momentum estimated in any given direction, is absolutely fixed, and has indicated that, except where friction and chemical changes interfere, the total amount of motion in the universe is unchangeable. The recent discoveries in galvanism and electricity shed a new light upon the subject.

The combustion of the coals, the chemical union of the carbon with the oxygen in the furnace of the steam-engine generates motion; that motion is extinguished partly by friction, and partly in effecting the disintegration of bodies; and it now seems more than probable that this rubbing and this subdivision of matter induces a state, and communicates that state to surrounding objects, which afterwards goes, in some distant quarter perhaps, to reproduce chemical changes preparatory to a new evolution of the like forces. Small, indeed, as that change must be when absorbed in the general mass, it is not on that account, the less real. The mass of stone that has been torn from the quarry, and fashioned into this splendid town, is minute indeed, yet, undoubtedly, that transference has retarded the rotation of the earth, although our senses, aided by every contrivance of science and art, be utterly unable to discern a trace of the change.

While, then, we zealously strive to improve our machines, and to remove the friction from the inefficient to be concentrated on the working parts, let us not repine that, after all our exertions, we are still compelled to resign a tithe of our labour to that influence under which alone it is possible for us or our machines to exist, and let us console ourselves with the thought, that, though our exertions be lost to us, nature has taken care that they conduce to the maintenance and well-being of the general system.

Edin. N. Philos. Journ.

Improvements in Steam Boilers and Saving of Fuel in Manufactures.

Accounts having appeared in the *Scotsman* and various other respectable journals, on the authority of a scientific gentleman of great eminence, of a discovery in heating and evaporating fluids, which, as it promises to lead to important results, we hasten to lay before our readers, referring them at the same time to the advertisement in another column. They are in substance as follows:

The discovery consists in the employment of air highly heated, to assist

in generating steam in boilers, and in the process of evaporation in general in manufactures. The air is heated by being carried through iron boxes, or troughs placed in the current of the flame, behind the bridge of the furnace. The current of the air through the trough effectually protects the metal from being injured, even in fires so fierce as to vitrify brick and speedily to melt cast-iron in juxta-position with the trough. When thus heated, the air is carried in straight tubes through the water in the boiler, entering at the back, and passing off at the front. Being unmixed with the smoke, it does not soil the tubes, which, therefore, rapidly transmit the heat; and the air in its passage is effectually cooled down to the heat of the water. In this state it is conducted under the ashpit, thus feeding the fire with air at the heat of 212 degrees, from which, as repeated analyses have shown, that it has parted with little or none of its oxygen, important benefits arise; the fire is saved the necessity of heating up to that degree the whole air which passes through it; and the process of combustion is otherwise beneficially promoted. The ashpit is closed with doors, and the draught of the chimney establishes and keeps up the requisite current of air for the purposes of combustion, through the heating trough, the cooling tubes, the fire, and the flues. The additional heating surface thus gained by the tubes in the boiler, exceeds the fire surface, or bottom of the boiler, by fully one-half.

This process, which is sufficiently simple, and the efficacy of which is vouched for by the gentlemen referred to, whose knowledge, experience, and skill, are of the highest rank, promises to be productive of very important results, both as regards steam-boilers, and manufactures where heating and evaporating fluids is required, such as distilling, brewing, dying, the making of paper, salt, sugar, and many others, especially in those in which the vessels containing the fluids are not placed on the fire, or where steam is now used for that purpose.

The saving of fuel was upwards of 33 per cent. in steam boilers, whose ordinary average performance is about 6.22 pounds of water to the pound of Newcastle coal, not deducting the ashes. In the other processes it must be commensurate with the quantity of the steam that escapes uncondensed; thus dissipating in the atmosphere a vast amount of heat derived from the fire, because, where air is used, no part whatever of its heat is lost, whereas, when any of the steam escapes uncondensed, all its latent heat is lost. Thus, 250 cubic feet of low-pressure steam per minute, of about 1200 degrees (temperature and heat), directed through tubes in seventeen cubic feet of water contained in a wooden trough placed on the ground, scarcely raised the water to 212 degrees, and could not make it boil, nearly the whole steam passing off in vapour when the water attained that heat. But 100 feet of air per minute, at about 600 degrees, caused the water to boil violently, and the same was the result when the quantity of air was successively reduced to one-half, and even much less.

The least consideration of the very many millions of tons of coal consumed in these processes, will show the importance of the discovery in this point of view. There are others, especially as connected with steam navigation, which, in other lights, are equally important. The free tonnage for goods or passengers will be enlarged, or the length of the voyage increased, in proportion to the diminished stowage and weight of coals and water in the boiler; for the boiler, as well as the fuel, and also the funnel, may be lessened one-third. The diminution of the boiler also tends to add to its strength; and the increased facility in transmitting to the water, the heat derived from the fire, arising from the greater heating surface afforded by

the tubes, must still farther operate to prevent the imminent hazard arising in marine boilers, from the exertions of the engineman to generate steam more rapidly. The only way in which this can be accomplished at present, is by forcing the fire of the furnace. By the intensity of the heat thus produced, many parts of the boiler and flues, especially those where incrustations have been formed on the bottom, or where the water spaces have been too much contracted, become overheated and consequently weakened, and ultimately destroyed. Whatever tends safely to accelerate and facilitate the transmission of the heat to the water, obviously diminishes the necessity to contract the water spaces, and the temptation to force the fire. It is also important that the heat which is absorbed by the air, is withdrawn from the fire at the point at which it is fiercest, and is, by a proper distribution of the tubes, applied to the portions of the water farthest removed from the direct influence of the fire.

If it shall be found, as we have reason to expect, that hot-air used in the furnace will enable anthracite coal to be burned, it is not easy to see to what extent of saving this discovery may lead in steam navigation; this coal being vastly more powerful than any other.

It is no small advantage to the public, and no slight recommendation of this plan, that not only does it not interfere with any other improvements for economy of fuel now in use, but it is rather an addition to, and may be used in conjunction with them, but also that it may be easily adapted to almost any existing furnaces, boilers, and processes of manufacture, at an expense altogether trifling, contrasted with the benefit resulting from its use.

'With regard to the license for its use, the patentee has wisely adopted the plan so successfully followed by the late Mr. Watt, in making the charge proportionate to the saving of fuel. We observe that he proposes to charge only one-third the value of the fuel saved in all cases.

We understand that a company is about to be formed, by which the benefits of this discovery will be immediately communicated to the eastern part of Scotland, by the sale of a portion of the income of the patent, and devolving on the company the management and control of the patent; and that the patentee is ready to treat for a similar arrangement for other districts, on terms highly advantageous to the company. It were well that after due inquiry, means should be speedily resorted to for securing the benefit of the improvements on this plan, for this great capital, and other districts of England. Mining Jour.

This application of hot air to the furnaces of steam boilers is ascribed by the Editor of the Mining Journal in another part of his paper, to Mr. William Bell, of Edinburgh, and its value is said to be confirmed on the authority of experiments by Dr. Fyfe. G.

Bell's Improvements in heating and evaporating Fluids.

With the view of putting the principle of his invention to the test, Mr. Bell made numerous experiments on a small scale, in which it was invariably found that there was an increase of evaporation when the hot air was used. In experiments afterwards conducted by Dr. Fyfe, at the request of the patentee, on a larger scale, and with an apparatus of a totally different construction, viz. a small wagon boiler, with flues through the centre—similar results were obtained. Many long trials were lately conducted under

the superintendance of the same chemist, at the manufactory of Mr. Morton, engineer, Leith Walk, who also superintended, on an eight horse engine boiler, with a flue through the centre, and surrounded also by flues. The ordinary average performance of this boiler, without the use of hot air, was 6.22 pound of water steamed off, to each pound of Newcastle coal. These, therefore, may be considered as trials applicable in practice, and in them the results were equally satisfactory. Of course, these results varied according to circumstances. In the most unfavorable, there was, when the hot air was propelled through the boiler, a saving of fuel to the extent of 17 per cent.; but the general result amounted to from 20 to 30 per cent. Taking the average of all the experiments, the saving was 23 per cent. In the apparatus last used, by which the above results were obtained, there is an iron box, situated immediately behind the fire, connected in front with a circular blower, by which air is propelled into the box, and from which it is conveyed by tubes through the boiler, where it gives off its heat to the water. By this means the air has been heated to 600 and upwards, in which state it enters the water, and, traversing it, comes off at 212, or thereabouts, having communicated the heat, necessary for raising it from 212 to 600 or 700, to the water, and by which the evaporation was increased.

It must, however, be evident that, by the transmission of air in this way, part of the heat must be lost; because it is given off from the boiler at the temperature of the boiling water. With the view of saving this, the patentee has adopted means by which the hot air, after having done its duty in the boiler, may be returned under the ash pit, so as to serve for combustion; thus, along with his own method, also applying a well-known principle, of aiding combustion by a hot-blast, and by which it is well known, there is a manifest advantage. When the hot air was thus returned into the ash-pit, it was found that the saving of fuel was greater than has been already stated; on an average, it amounted to upwards of 33 per cent.

In trials which have been made, also under the superintendance of Dr. Fyfe and Mr. Morton, by passing the hot air in tubes through water, but without mixing with it, and under which there was no fire, it was found that the water was made to boil, and was kept boiling. On one occasion, the steam from a low-pressure engine boiler, passed in pipes through a large trough with water, did not act so powerfully as 100 feet of air, at about 600 degrees of heat, propelled through the fluid per minute. Now, from this boiler there must have passed about 250 feet of steam in the same time.

We are aware that objections may be, and indeed have been, urged against this plan. It is supposed that the box in which the air is heated will soon be destroyed, by the great heat to which it is exposed; but that is not the case. It seems to be protected from injury by the constant current of cold air introduced into it; the box employed in the trials at Mr. Morton's, though it has been long in use, is not in the least injured. Another objection brought against the plan is, the power required for propelling the hot air through the system of tubes, and by which it is of course supposed that a part, or even the whole of the saving effected, must be consumed, and consequently that there can ultimately be no saving. But this objection, though plausible, does not hold true. Those who have advanced it seem to have had in their minds, at the time, the propulsion of the hot blast in furnaces for smelting iron; but the cases are very different from each other. In the latter, the air has to pass through a mass of semi-fused materials in the furnace, and consequently requires a considerable power to do it; but in the latter the air has merely to travel through tubes, in which it meets little or no resistance,

so that the power required is trifling. But even this is not necessary; for, in those cases where the hot-air is to be returned into the ash-pit for combustion, the ash-pit is closely shut, and it has been proved that the draft up the chimney is all that is required to maintain a constant and adequate current of air through the heating box; so that, by this mode of using it, no additional power whatever is required.

It may also perhaps be urged, that, as the air has to pass over hot iron, its oxygen may be abstracted, and that thus its utility for the purposes of combustion may be expended or destroyed. In all trials, however, that have been made, it was found that this was not the case. The air has been analyzed by Dr. Fyfe, and never found to have lost more than three or four per cent. of its oxygen, while in other trials, there was little or no change in its composition.

Lond. Mec. Mag.

Chinese mode of Printing.

"The mode of printing adopted by the Chinese is of the simplest character. Without expensive machinery, or a complicated process, they manage to throw off clear impressions of their books, in an expeditious manner. Stereotype, or block printing, seems to have taken the precedence of moveable types in all countries, and in China they have scarcely yet got beyond the original method.

* * * * * * * *

"The use of wooden blocks has not been without its advantages; among which we may enumerate speed and cheapness. The first part of the process is, to get the page written out in the square or printed form of the character. This having been examined and corrected, is transferred to the wood in the following manner:—The block, after having been smoothly planed, is spread over with a glutinous paste; when the paper is applied and frequently rubbed, till it becomes dry. The paper is then removed, (as much of it as can be got away,) and the writing is found adhering to the board, in an inverted form. The whole is now covered with oil, to make the letters appear more vivid and striking, and the engraver proceeds to his business. The first operation is, to cut straight down by the sides of the letters, from top to bottom, removing the vacant spaces between the lines, with the exception of the stops. The workman then engraves all the lines which run horizontally; then, the oblique; and, afterwards, the perpendicular ones, throughout the whole page which saves the trouble of turning the block round for every letter. Having cut round the letters, he proceeds to the central parts; and, after a while, the page is completed. A workman generally gets through one hundred characters a day, for which he will get sixpence. A page generally contains five hundred characters. When the engraver has completed his work, it is passed into the hands of the printer, who places it in the middle of a table; on one side is a pot of liquid ink, with a brush; and on the other a pile of paper; while, in front, there is a piece of wood, bound round with the fibrous parts of a species of palm, which is to serve for a rubber. The workman then inks his block with the brush: and taking a sheet of dry paper, with his left hand, he places it neatly on the block; and seizing the rubber with his right hand, he passes it once or twice quickly over the back of the paper, when the impression is produced, the printed sheet hastily removed, and the workman proceeds with the next impression, till the whole number is worked off; and thus, without screw,

lever, wheel, or wedge, a Chinese printer will manage to throw off 3000 impressions in a day. After the copies are struck off, the next business is to fold the pages exactly in the middle; to collate, adjust, stitch, cut and sew them; for all of which work, including the printing, the labourer does not receive more than ninepence a thousand. The whole apparatus of a printer, in that country, consists of his graves, blocks, and brushes; these he may shoulder and travel with, from place to place, purchasing paper and lamp-black as he needs them; and, borrowing a table anywhere, he may throw off his editions by the hundred or the score, as he is able to dispose of them. The paper is thin, but cheap; ten sheets of demy size, costing only one half-penny. This, connected with the low price of labour, enables the Chinese to furnish books to each other for next to nothing. The works of Confucius, with the commentary of Choo-foo-tsze, comprising six volumes, and amounting to four hundred leaves, octavo, can be purchased for nine-pence: and the historical novel of the *three kingdoms*, amounting to 1500 leaves, in twenty volumes, can be had for a half-a-crown. Of course, all these prices are what the natives charge to each other; for all which Europeans must expect to pay double.

"Thus books are multiplied, at a cheap rate, to an almost indefinite extent: and every peasant and pedlar has the common depositories of knowledge within his reach. It would not be hazarding too much to say, that in China there are more books, and more people to read them, than in any other country in the world."—p. 103.

Many of the praises here bestowed by Mr. Medhurst on the Chinese practice, must be taken with very considerable allowance. We cannot very well see why the attribute of "speed" as well as "cheapness" is to be ascribed to it. From his statement it would appear that a workman is occupied five days in producing a block for a single page of a common size. What sort of "speed" is this compared to that attained by the use of single types? And by what miracle could the Chinese, with their "speedy" method, manage to get out such a sheet as the double *Times*, in the course of a few hours? The thing is clearly impossible; and Mr. Medhurst would therefore have done better not to adduce rapidity as one recommendation of a process, which, in its very nature, must be slow. The "cheapness" is also rather problematical. True, the expense of engraving a page does not strike the English reader as any way alarming; but engravers are not to be had every where for sixpence a day. The process is only comparatively, not positively, cheap,—cheap, not from its inherent simplicity, but merely on account of the cheapness of labour in China, from the overstocked state of the labour market. Did the Chinese language admit of the introduction of movable types, (which a former Emperor once attempted,) and were the Chinese acquainted with the art of type-founding, our system would be far cheaper than their own, it being recollected that where wood engravers are to be had for a sixpence a day, type-founders must be procurable at a proportionate sum. To make the matter clear, let us only imagine the reverse to take place,—the introduction of the Chinese method into England. Supposing our artist be as expert as his Eastern prototype, and to be satisfied with six shillings a day, (no very extravagant wages it will be owned,) here are at once thirty shillings for the labour alone of "setting up" a single page—and that, too, a page only of the extent of one of our *columns*, reckoning every "character" to represent a word. This, indeed, is allowing nothing for the casting of the types, but this may be set against the value of the Chinaman's block, which, it should be borne in mind, will serve for only one page, while

the more expensive type may be distributed and set up again *ad infinitum.*

The mode of obtaining the impression is a different matter altogether; in this case something is likely to be gained from an observation of the Chinese fashion. Our ideas are so bound up with "the press," that it appears to us an essential of "the glorious art;" and we are so often in the habit of toasting "the Liberty of the Press," that it seems almost sacrilegious to compass and imagine the printing of a book without its aid. Yet the Chinese have printed for ages without having heard of "the Press" at all! The great simplicity of their process is a most striking feature, while even the limited experience which has been had of it in England, (where a similar method is adopted for taking engravers' proofs, &c.) is sufficient to demonstrate that it is compatible with the highest degree of typographical excellence. Would it not be worth the while of some of our ingenious mechanics to turn their thoughts in this direction? Ingenuity has been lavishly bestowed on the improvement of the printing press, until the maximum of power in that engine may be presumed to be attained. Why not try invention on another tack, and apply English skill in machinery to the perfecting of a mode of printing on the Chinese plan, where the impression is obtained by a gentle friction, instead of a tremendous direct impression? Could this be achieved, it would probably be one of its not least important results, that type might be made of a much less valuable material than at present, and by a much less expensive and elaborate method. At any rate the attempt is worth making,—though it would probably be necessary to commence by introducing a much softer texture of paper than that now used, and, perhaps, to print, like the Chinese, on one side only.

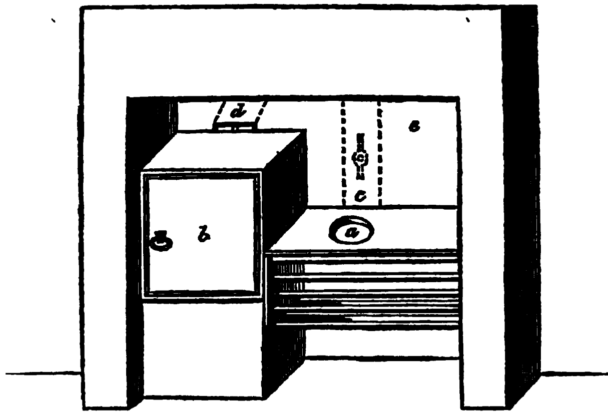
Mr. Medhurst is again, towards the conclusion of our extract, rather too solicitous to exalt the cheapness of Chinese literature. The number of volumes to be had for a few pence may seem rather startling, but then he should have stated, that the volumes of Chinese books are by no means of such substantial dimensions as our own. For instance, the six volumes of Confucius, it appears, contained altogether only four hundred leaves, (that is, four hundred *pages*, being printed on one side only,) containing only about half as much as a common English volume of the octavo size. Nine-pence certainly seems low enough for this quantity of matter, but then this sum of nine-pence in China, be it remembered, forms the whole earnings of an artist for a day and a half; so that, all things considered, it is evident that our own standard works are sold at a much lower rate than this much-vaunted and inconceivably cheap edition of the great Chinese classic. If books, therefore, are sold in China for "next to nothing," what are we to think of the price of such commodities at home? It would be as well for Mr. Medhurst to avoid such mystification for the future.

Ibid.

Notice of an improvement of a common Fireplace; by M. Saul.

I herewith send you a plan of a common fire-place, which is found to have several great advantages over the old plan. From an inspection of the drawing, I presume it will be understood that on the grate is fixed a cast-iron plate with a circular aperture in the centre at *a*. It is 8½ In. in diameter, which just takes a common tea-kettle, and answers well for other sized pans, as I find it is of no moment, the pan being larger than the aperture. By this plan the heat is confined in the grate; and by several exper-

iments, I have proved that anything will much sooner boil in this closed grate than in an open one; and it also throws out a greater heat in the



room, and prevents smoke; and, when the fire is not wanted for cooking, there is a plate to cover the aperture. It also consumes less fuel, and is a sure remedy for a smoky chimney. When an oven is also made in the same fireplace, as seen at *b*, the whole heat is made to pass upon the oven by turning the damper in the flue, *c*, which is behind the iron plate, when the smoke is carried up the oven flue (*d*). When the oven is not wanted, the flue *d*, is closed with the damper, and then the smoke rises through the flue, *c*. A small aperture is made on the top of the iron plate at *e*, to admit any smoke that may arise when putting on the fuel, or changing the kettles or pans.

This plan may be adapted to any grate now in use. It is only necessary to get a cast-iron plate the size of the grate. It is to rest on the top bar of the grate, and on the brickwork on the back; and a small aperture is to be made for the smoke to escape, and an iron plate fixed in front, to prevent the smoke from entering the room. Arch. Mag.

Action of Sulphate of Ammonia upon Glass; by R. F. Manhand.

A mixture of muriate and nitrate of ammonia strongly corrodes glass, particularly glass containing lead. Sulphate of ammonia has precisely a similar action. As this salt upon being heated parts with a portion of its base, it may be considered as a salt with excess of acid. When heated in a glass vessel to the temperature of 316° Fahrenheit, it begins to melt: up to 600° Fahrenheit, it does not suffer any further changes; at this temperature ammonia is driven off, sulphate and sulphite of ammonia sublime and the glass vessel is much corroded. The whole inner surface of the glass becomes dim, while the sulphuric acid combines with the potash, and probably the ammonia as it is driven off combines with the silicic acid. The glass generally flies to pieces and in the centre is much acted upon; the fragments are fused with difficulty, and are recognised by the blowpipe as sulphate of potash.

I have often further remarked that the watch glasses (containing lead) which I am in the habit of using, to dry substances in vacuo over sulphuric acid, after from two to four weeks become covered with numerous flaws, and small splinters may be easily separated from them. I have not been able to de-

tect any loss of weight, therefore the appearance cannot be due to the abstraction of any air contained in the glass, as Bischof, who observed something similar, surmises. I have never observed the same action to take place upon the glass of the air-pump, or upon other glass.—*Poggendorff's Annalen*, 1837, *No.* 12. Lond. and Edin. Philos. Mag.

On a fossil stem of a Tree recently discovered near Bolton-le-Moor; by Dr. Black, F. G. S.

Communicated to the Geological Society, May 9, 1838.

The rock in which this fossil was found, occurs in the middle of the coal-measures, about 50 yards beneath a six-feet bed of coal, and it rests upon another bed four feet thick. It consists of three strata of argillaceous sandstone dipping from 15° to 18° to the south-west, and amounting in all to about 40 feet in thickness. The upper portion of the fossil stem was discovered about thirty feet beneath the surface of the rock, and the lower end extended to within 5 or 10 feet of the adjacent bed of coal. It was inclined 18° to north-east, or in an opposite direction to the sandstone strata; and, when first laid open, it appears to have been about 30 feet in length. but at the time it was examined by Dr. Black only 12 feet remained *in situ*. The upper end of this portion was 15 inches in diameter, and the lower 9 inches. The whole of the exterior of the stem was singularly striated, and irregularly furrowed, as if by compression; and it was coated with a layer of coal, which evidently occupied the place of the bark. The interior of the stem is stated to be composed of a dark, hard, argillo-ferruginous sandstone, having a specific gravity of 2.9. A Sternbergia, about an inch in diameter, extended along the whole length of the stem, and in some parts appeared to be half imbedded in a groove in it. This connexion of the two plants was Dr. Black's principal object in making the communication to the Society, not having previously observed a similar occurrence, nor having heard that it had been noticed elsewhere by other collectors. He is of opinion that the Sternbergia was not accidentally allocated with the larger stem, but that it was, while living, a parasite, and in this respect resembled the mighty creepers of the existing tropical regions. Ibid.

Progress of Physical Science.

South Staffordshire Coal Fields; by Frederick Burr.

This remarkable district, "the present ascertained area of which is scarcely equal to a hundred square miles," is chiefly situated in "a small isolated patch of Worcestershire which lies within the county of Stafford and some distance to the north of the general boundary of the former county." Its principal town is Dudley, which is built mostly of brick, and contains about 23,000 inhabitants who are in a great measure supported by the adjacent mines and mineral works.

This coal field possesses one very striking peculiarity in a geological point of view, the millstone grit and carboniferous limestone are entirely wanting, and the coal, in the absence of its usual substrata, rests upon a more ancient formation of limestone. It differs also from our more northern coal fields in containing comparatively few beds of sandstone, and those generally thin and of but small importance, the great mass of the formation being made up of shale beds, in which many seams of coal and ironstone occur, several

of the former being of great thickness and value, while some of the ironstone measures are equally productive.

The general dip of this coal field is towards the south, or rather the southeast, but it exhibits several remarkable curvatures and fractures of the strata, which are not only of much geological interest, but of great local importance, as bringing the beds of coal nearer to the surface, and allowing the underlying formation of limestone to be easily worked, although in its natural position so deeply seated as to be scarcely accessible for those purposes to which it is so largely applied. The main or ten-yard coal is situated about the middle of the series, which presents in all eleven seams of coal, five being above, and five below the main bed.

The principal curvatures and contortions of the strata will be readily understood on reference to the accompanying sketch, representing a section of the Staffordshire coal field from north-east to south-west, of which it will convey a good general idea, although not pretending to local accuracy or detail. It will be seen that the general continuity of the coal measures to the southward, is interrupted by two lines of elevation, one occurring near Walsall, the other near Dudley, and the underlying limestone is in both cases brought to the surface. Two anticlinal axes are thus formed, the most prominent and decided is however that at Dudley, which extends completely across the coal field, separating it into two great troughs or basins. Each of these lines of elevation is marked by an eruption of basalt, but that to the south of Dudley is by far the most extensive and important. The numerous faults occurring in the district, are of course not attempted to be shown in this little diagram.

In proceeding briefly to describe in a descending order the various strata existing in the vicinity of Dudley and the surrounding coal field, they may be enumerated as follows:—recent or diluvial deposits—new red sandstone—coal measures—Dudley limestone, and basalt.

The diluvial deposits consist of beds of sand and gravel, the former loose and incoherent, the latter often much indurated. These deposits appear to be indifferently spread over both the coal strata, and the surrounding new red sandstone, and are too general in their occurrence to require any particular notice. At Moseley and Edgbaston, near Birmingham, they cover the new red sandstone, between Oldbury and Wednesbury they are spread over the coal strata, and to the north of the coal-field extensive deposits of this kind may be seen between Lichfield and Rugely. The diluvial deposit near Oldbury, is of a very remarkable character, it consists of loose sandy soil, containing besides the pebbles usually found in such situations, *rolled masses or boulders of coal.* This deposit is with much justice considered in the neighbourhood as indicating the site of an ancient river. It may probably be referred to some ancient rush of water, occasioned by the altered drainage of the neighbouring country, at one of the great periods of elevation marked by the basaltic eruptions of Dudley and Walsall.

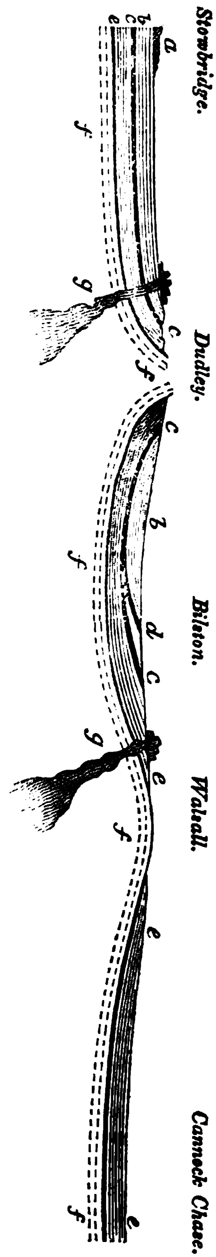
The most striking feature which this coal field presents, is the extraordinary bed, or rather assemblage of beds, called the "ten-yard coal," which, as before observed, is confined to the southern half of the coal-field, and there forms the principal object of mining operations. The ten-yard coal is most extensively worked in the neighborhood of Dudley, which lies nearly in the centre of it, and where it is found on both sides of the anticlinal axis formed by the limestone range, the depth from the surface being generally about 120 yards.

The depth of this bed of coal varies much, however, in different situa-

tions, being influenced both by its general dip, and the intervention of faults It may be stated as usually occurring at from one to two hundred yards below the surface, which is the general limit of the depth of the collieries. In some of the older mines it was found, however, at a much less depth toward its outcrop, but these are now nearly exhausted. It may be mentioned, as a remarkable fact, that coal is stated to have been obtained near Wolverhampton, by *open cutting*, probably the only instance of the kind which has ever occurred in the kingdom. The ten-yard coal presents the very singular phenomenon of the successive deposition of carbonaceous matter, with scarcely a trace of the intervening earthy deposits which usually form such thick masses between the seams of coal. We have here, therefore, a striking contrast to the usual circumstances attending the deposition of coal, the carbonaceous matter having been (if the expression may be allowed) in excess, while the earthy matter usually so abundant appears to have been almost entirely wanted.

The ten-yard coal is made up of twelve or thirteen seams of various qualities, each having its distinct local appellation among the miners, and separated from the others by a thin parting of shale. The structure of this remarkable bed will, however, best be understood by reference to the annexed sketch taken from Mr. Thomas Smith's valuable Chart of Sections of the Staffordshire and other coal fields. As regards the quality of the coal, it is deserving of notice, that the best is found occupying the middle of the bed and about half its entire thickness, while the seams both above and below are very inferior, although extensively used in the neighbouring iron furnaces. The variety of circumstances under which the deposition of coal was carried on even within a very limited area, receives an admirable illustration from the singular phenomenon which characterises the crop of the ten-yard coal towards Bilston, and which is provincially termed, the "flying reed." The two upper seams of the bed become gradually

SECTION ACROSS THE SOUTH STAFFORDSHIRE COAL-FIELD.



a, new red sandstone. *b*, beds above the ten-yard coal. *c*, the ten-yard coal. *d*, the "flying reed." *e*, beds below the ten-yard coal. *f*, Dudley limestone. *g*, masses of basalt.

The two dotted lines show the two beds of pure limestone, which alone are worked for lime.

separated both from the lower seams, and from each other, by the gradual interposition of thin, wedge-like masses of rock, which at first form merely narrow partings between them, but increasing in size to the northward, at length present several beds of shale and sandstone, interpolated between the three beds of coal into which the ten-yard coal is then divided. The two upper beds, termed the "flying reed," rise quickly to the surface, but the principal mass of coal lying beneath them, crops out still further to the northward. Large portions of this rich bed of coal are now exhausted; and great subsidences of the surface have consequently taken place above the excavations, as is often apparent from the cracked and inclined position of the houses and other buildings.

The beds lying above the ten-yard coal are but little worked, both from being thin, and from their proximity to a much more abundant deposit. The beds lying below it, are, however, worked very extensively in the northern part of the district, and have an average thickness equal to that which is generally observed in the north part of England. The Staffordshire coal differs considerably from that of Newcastle, being of a less bituminous nature; it burns very readily, making an excellent fire, and leaving a residuum of white ashes. When used for the purpose of making gas it is found to afford from thirty to thirty-five per cent. less from a given quantity than the Newcastle coal; and its heating power is considered to be inferior in nearly the same proportion. From the peculiar nature of this coal the loss of weight sustained in coking is very great; it is generally, indeed, estimated to amount to full one-half.

The ironstone, although found in many of the strata, is chiefly worked in two thick beds lying below the main or ten-yard coal, and is the common clay ironstone of the coal measures. It generally occurs in septaria-like nodules, imbedded in soft clay, forming seams from one to four yards or more in thickness. Iron pyrites occurs very abundantly in some of the beds of coal, and good specimens of columnar clay-ironstone are found near Wednesbury. About three tons of ironstone are used on an average in the furnace to obtain one ton of pig-iron.

The shale and argillaceous beds, provincially termed "clunch," as previously observed, constitute the principal mass of the Staffordshire coal formation; the former exhibit the usual characters of coal shale, but are frequently more compact and indurated, assuming the appearance of some of the older shales—a circumstance, no doubt, attributable to the proximity of the basaltic mass, which may be presumed to underlie the greater part of this coal-field, since in addition to the erupted masses already noticed, it is found at a great depth in dykes and wedge-form masses in many of the coal mines. Some of the argillaceous beds of the coal measures afford excellent fire-clay, and are extensively worked for this purpose, but the most valuable is that found near Stourbridge, from which the celebrated Stourbridge fire-bricks are made.

The sandstone is usually argillaceous, and is provincially termed "binds," or when much indurated, "rock binds." The small development of this rock appears to indicate a more quiet disposition than that which took place in the northern coal fields, although occasional intervals of disturbance, probably contemporaneous with the eruptive movement, of the underlying basalt, are clearly indicated by some of the sandstone beds, and a coarse conglomerate, expressly called by the miners "rough spoil." The sandstone beds afford in some situations excellent fire-stone, as at Gornal near Dudley, at Tipton, and other places. This material is extensively used in the

construction of the iron furnaces, the hearths of which are formed of it, the upper part being built of fire-bricks. The entire thickness of the various beds constituting this coal formation is generally considered as somewhat exceeding three hundred yards.

The faults which traverse the Staffordshire coal field are, as before noticed, very numerous; the strata are, indeed, so much shattered and dislocated, that in any new trial much uncertainty exists as to the depth at which the seams of coal will be found. Many of the faults occasion a throw of more than fifty yards, and one near Bilston amounts to ninety or a hundred. Saline springs rise in some places from the coal measures, and their situation, I have been informed, coincides with that of the faults, a circumstance calculated to throw much light on the origin of the rock salt deposits of the adjoining county of Worcester.

The highly interesting formation of limestone, which underlies the Staffordshire coal field, and which from its prominent appearance at Dudley has received the name of the "Dudley limestone," although here placed in immediate contact with the coal strata, is well-known to be of much higher antiquity, its true place in the order of stratification being below the old red sandstone, where it forms one of the members of the series of ancient shales and limestones, formerly vaguely grouped together in the class of transition rocks.

The Dudley limestone is the oldest stratified rock which is known in the Staffordshire coal field, and is so deeply seated below the coal, that had it not been raised to the surface by powerful volcanic agency, but little would now have been known of its existence, while the surrounding mineral district, in the absence of this limestone as a flux for smelting the ironstone, could hardly have attained its present wealth and importance. This formation appears at the surface in two places only, though seen in the coal mines in other spots also.

There is a considerable variety both in the texture and appearance of the limestone under consideration, some of the beds being compact and subcrystalline, while others are loose and earthy. At Dudley the colour is whitish or greyish, and the two strata of hard, pure limestone which have been so extensively worked for supplying the iron furnaces, are separated by softer thin argillaceous beds, of a marly nature, termed by the quarrymen "bavin." It is chiefly in these beds that the well-known fossils which characterise the series are found. The limestone beds which are exposed at Sedgeley, are of a blackish colour; and similar characters are exhibited to the east of Walsall. The fossils contained in the Dudley limestone are remarkable for the beauty and the delicacy of their preservation; they consist of *trilobites* (especially the *Calymene Blumenbachii,) terebratulæ, corallines, encrinites, &c.* converted into limestone, and projecting in fine relief from the upper surface of the strata. A single specimen will not unfrequently present a perfect series of the most characteristic fossils, so thickly are they studded on the surface of the rock. It is therefore evident that at the time the limestone strata were deposited, the superincumbent ocean teemed with animal life to a most extraordinary degree, while from the appearance of the strata, and the fossils they contain, it is certain that their deposition was slow and uninterrupted, and that the period of volcanic eruption which subsequently prevailed had not then commenced its action. During this period of tranquility it would not, however, seem improbable that a quiet, but copious deposition of calcareous matter from *thermal springs* may have had a considerable influence in producing a formation of

limestone so prolific in animal life, and this may have been the first effect of that powerful volcanic energy, which at a subsequent period broke forth with such violence as to convulse and shatter the surrounding coal field in the manner we now find it.

The limestone is very extensively worked both in the neighbourhood of Dudley and Walsall, especially the former, where its inclined position at the surface renders it more easily accessible than in most other places. The outcrop of the beds having been long ago exhausted by open cutting, recourse has been had to subterranean working, and excavations of vast magnitude have been formed upon the two strata, which furnish limestone of sufficient purity for use. They are about twelve yards each in thickness, and separated by a considerable mass of the thin marly strata before noticed; the two workable beds are generally termed by the miners the "blue lime." The excavations somewhat resemble the workings of a coal mine, but from the great thickness and indurations of the beds, they are far more lofty and spacious, presenting immense vaults or chambers, with massive pillars to support the roof. They may be seen to great advantage below the Castle Hill at Dudley, where an underground canal of rather more than a mile in length has laid open all the limestone beds in succession; nor can a more striking scene be well imagined than is presented by this remarkable spot, which is so readily accessible as to be examined without difficulty even by those who are least accustomed to subterranean explorations. At the Deepfield mines near Bilston, the upper bed of limestone has been reached by sinking completely through the coal measures, and is there ten yards in thickness.

Although of little value compared with the formations previously noticed, the basaltic masses which protrude through the Staffordshire coal field afford objects of equal interest to the geological traveller. Commencing a little south of Dudley, the principal mass of basalt extends in a south-easterly direction to the village of Rowley, a distance of about three miles, forming a range of hills, which, although elevated eight or nine hundred feet above the sea level, is not very prominent or abrupt. The basalt itself is generally concealed by the soil, but is well exhibited in several quarries which have been opened upon it. In one or two of these quarries the columnar structure of the rock, although not perfectly developed, is distinctly marked, but in others it is hardly discernible. The mass of basalt forming the eminence called Pouck Hill, about two miles from Walsall, appears, however, to have been formed under circumstances much more favourable to the development of the columnar structure, than that of Rowley Hills, as it forms a series of very perfect prisms, which are arranged with considerable regularity, either in a horizontal or slightly inclined position. The range of basaltic hills to the south of Dudley is considered to form a vast overlying mass, connected with some great eruptive dyke, which probably also extends, although at a considerable depth, below the limestone hills. I have been informed that the coal has in some places been worked underneath the basalt, but never to the point of junction.

The basalt of Staffordshire presents the usual characters of this rock, it is of a deep, black colour, hard, compact, and slightly crystalline, affording a plane and tolerably even fracture. Several specimens which I have tried affect the needle very perceptibly, showing that a portion of the iron contained is in the state of the protoxide—a circumstance which appears rather singular in a rock which must have been exposed to a degree of heat so

intense and long continued.* The basalt, as far as I have been able to observe it, appears to be tolerably homogeneous, the joints or separations of the rock presenting the usual ochry appearance. The purposes for which the quarries have been opened are chiefly paving and mending the roads, and the basalt is familiarly termed by the quarrymen, "Rowly rag," a name derived from its principal locality. I believe some attempts have also been made to use the basalt in making the common green bottle glass, a purpose for which this material does not appear by any means inapplicable.

The quantity of iron made in Staffordshire in the year 1827, has been stated from official documents, at 216,000 tons, the produce of ninety-five blast furnaces. In the following year (1828), the quantity of iron is stated in Marshall's Statistics, at 219,492 tons, also the produce of ninety-five furnaces, twenty-five being then out of blast. For the ten years which have since elapsed, I am not aware that similar statements have been made, and from the well-known fluctuations in the iron trade, the quantity must have been varied much. It is generally considered, however, that about a hundred furnaces are now in blast in Staffordshire, and if we take the weekly produce of each as being, on an average, forty-five tons, which will probably be near the truth, it will give a total yearly produce of 234,000 tons of pig iron. During the great demand for railway and other iron, which prevailed two or three years ago, it is probable that the quantity may even have exceeded this amount, while, in the intermediate period of depression, it must doubtless have fallen much short of it.

As regards the quantity of coal produced in Staffordshire, our means of information are less perfect, no statement of the amount having, I believe, ever been published. From the quantity consumed in the iron furnaces, it will, however, be possible to form at least an approximate idea of the total amount. If we assume that, on an average, six tons of coal are consumed in producing one ton of pig iron, and this certainly does not exceed the fact, we shall have a consumption of 1,404,000 tons of coal annually in the smelting of iron alone. Of the 234,000 tons of pig iron yearly produced, probably about two-thirds are converted into bar iron, thus requiring a vast additional consumption of coal. Every colliery has one or more steam-engines for winding the coal; most of them an engine for drawing water also, and in these engines the coal is most profusely, or, rather, indeed, extravagantly used. When we add to these demands the consumption of the dense population of the neighbouring district, of the manufactories of Birmingham and other places in the vicinity, the quantity employed for burning lime, and other minor uses, it will not, perhaps, be an exaggeration to double the quantity used for the iron furnaces alone, and to state the quantity of coal produced by the South Staffordshire coal field, at little short of 3,000,000 tons per annum.

The quantity of limestone quarried annually by processes more laborious and expensive than are generally required in obtaining this mineral, is not undeserving of notice. It is generally considered that about one ton of limestone is required in smelting a ton of iron, thus giving a consumption of limestone in the iron-works alone of more than 230,000 tons per annum. If to this we add the quantity used for mortar and cement, for manure and other purposes, it will be evident that the produce of limestone must equal, if not exceed 300,000 tons per annum.

The fire-clay obtained at Stourbridge and other places, and the gritstone

* This property is not, however, peculiar to the Staffordshire basalt.

quarried for making the bottoms of furnaces, would form another item in the subterranean produce of the mineral district under consideration, but of the annual quantity of these no estimate can be formed. Enough has, however, been stated to show the extraordinary wealth of the South Staffordshire coal field, the present ascertained area of which, it may be further observed, is scarcely equal to a hundred square miles.

The number and condition of the population concentrated upon this small but important mineral district, and deriving their support entirely from its subterranean produce, is a subject fully as interesting as any which have been touched upon in the present sketch, but which can only be briefly and imperfectly noticed here. Stourbridge, Hales Owen, Dudley, Wolverhampton, Wednesbury, and Walsall, rank as towns, and with the important neighbouring villages of Bilston, West Bromwich, Oldbury, Tipton, Sedgeley, King's Swinford, Rowley Regis, Darlaston, and Willenhall (scarcely inferior to them in size), possess an aggregate population considerably exceeding 200,000 persons. Places of minor importance are, of course, very numerous, and, together with the scattered houses, must contain a large population. Even Birmingham, with its 150,000 inhabitants, might fairly be reckoned as forming part of the population of the South Staffordshire mineral district, for, although not located upon it, the prosperity, almost indeed the existence of the town, has been dependent on its proximity.

It would occupy a far greater space than can be here devoted, even to glance at the varied and ingenious species of industry by which this vast population is supported, all taking their rise from the subterranean produce of the district under consideration. At Dudley, nails and various articles of hardware are manufactured; at Wolverhampton locks and articles as steel; at Walsall, bits, stirrups, spurs, and articles of hardware; while at Birmingham, the emporium of the neighbourhood, the manufacture of trinkets, jewelery, fire arms, and every species of hardware, whether delicate or massive, ornamental or useful, is carried on to an extent unparalleled in any other part of the world, and justifying the expressive epithet of Burke, who called it the "toy-shop of Europe." In addition to the characteristic manufacture of every town within the district, the universal occupation of making nails should not be forgotten. The business of the nailor is almost peculiar to Staffordshire, and unlike most other manufactures, is carried on with patriarchal simplicity in almost every cottage throughout the southern part of the county.

The progress of this active scene of universal industry is greatly facilitated by the numerous canals which traverse the country in all directions, converging to Birmingham as their common centre, and by means of the Grand Junction Canal, communicating even with the Metropolis. The operations of the mines and furnaces are, of course, facilitated by the innumerable local train-ways, thus reducing, by all the powers of art, the cost of transporting the bulky produce of the soil to the spots where it is required. Staffordshire, however, unlike most other mineral districts, exports but little of her raw produce, nearly the whole being finally worked up on the spot, and exported in a manufactured state.

It will be seen that the vast industrial fabric at which we have now so briefly glanced, is entirely dependent for its existence on the enormous supply of coal produced by the neighbouring district; and the richest deposit of this mineral, the "ten-yard coal," has already been spoken of as partially exhausted. The question naturally arises, then, how long will the present supply continue, and the district be maintained in its present flourishing

condition? To this important query a general answer only can be given. It is certain that the quantity of coal contained in the district has been greatly reduced, both by actual consumption, by unnecessary waste, and by unfortunate subterranean combustion: on the other hand, however, it is probable that the beds below the main coal may yet contain a large reserve in the northern portion of the coal field, and even that they may hereafter in some cases be worked with advantage in places where the upper coal is now nearly exhausted; while (which is far more important) the peculiar geological features of the country indicate the probability of a great extension of the coal measures beyond their present known limits. It will be seen that this coal field, unlike many others, is not bounded by more ancient rocks which crop out from below, and positively circumscribe its limits. It is, on the contrary, surrounded by the new red sandstone, below which a large portion of it dips, extending for an unknown distance, and existing at an uncertain depth. To this great extension of the coal field, we may look, then, for a supply for future ages, when the present known beds shall have become exhausted; and the trials which have been made within the last few years show that we shall not look in vain. It is understood that this interesting subject has been very ably investigated by Mr. Murchison, and will be fully treated on in his forthcoming work on the "Silurian Region;" any further notice of it here would, therefore, be superfluous.

Much greater economy in the working of coal has, fortunately, of late years been introduced in Staffordshire, and even the satisfactory prospect just noticed does not diminish its necessity; for, although there is every probability that the district itself may continue to be productive of minerals, long after the present working tract is exhausted, still the deterioration of existing property of every kind must be immense, whenever the population and the seats of manufacturing industry shall gradually be obliged to settle in new localities, in consequence of the opening of new mines, and the exhaustion of the old ones. It must also be remembered that the present mineral tract can never return back to its primitive condition of an agricultural district—encumbered with mouldering piles of masonry, with enormous masses of slag and cinder, the produce of the iron furnaces, and with heaps of refuse from the mines, its aspect, when abandoned, will resemble that of an extinct volcano, and its value will be literally reduced to nothing. Without wishing to lay an undue stress upon the future, it would, perhaps, be well were considerations like the foregoing to have some little weight in our coal districts, at least so far as to prevent unnecessary waste of that valuable substance, which, however abundant in this country, is still positively limited in its quantity, and absolutely incapable of reproduction.

Mining Rev.

On the Composition of certain Mineral Substances of Organic Origin; by James F. W. Johnston, A.M., F.R.SS. Lond. and Ed., F.G.S., Professor of Chemistry and Mineralogy, Durham.

Ozecerite from Urpeth Colliery, near Newcastle-upon-Tyne.

The attention of chemists and mineralogists has for several years past been drawn to a species of fossil wax found in Moldavia, in sufficient quantity to be employed for economical purposes, and to which the name of

Ozercerite has been given.* This substance is of a brown colour, of various shades, has the consistence and translucency of wax, a weak, bituminous odour, sometimes a foliated structure and conchoidal fracture, and can be reduced to powder in a mortar. In burning, it emits considerable light, and is said to be used for the manufacture of a species of candles.

The chemical and physical proporties of this substance were first examined by Magnus (*Ann. de Chem. et de Phys.* lv., p. 218) more lately by Schrotter (*Bibliothèque Univ.*, May, 1838); and most recently by Malaguti (*Ann. de Chem.* lxiii. p. 390); who agree in representing it as a mixture of several substances, differing in their physical properties, yet possessing the same ultimate chemical constitution.

The occurrence of a fossil body, possessing many of the characters of Hatchetine, and having much resemblance to the fossil wax of Moldavia, in a coal mine in this neighbourhood, where no doubt could exist as to its origin, has afforded me an opportunity of adding to our knowledge of this class of mineral compounds, while it seems to indicate pretty clearly their common organic origin wherever they may occur.

In driving through a *trouble* in Urpeth Colliery, at a depth of about 60 fathoms from the surface, this substance was found in cavities near the sides of the trouble, and sometimes in the solid sandstone rock; it occurred in considerable quantity, and was sufficiently soft to be made up into balls by the workmen.

The specimen sent to me by my friend Mr. Hutton, of Newcastle, is soft, unctuous, sticking to the fingers, and giving a greasy brown stain to paper; semi-transparent; by transmitted light, of a brownish yellow colour; by reflected light, yellowish green and opalescent; having a slight fatty odour, more perceptible when the substance is melted. It fuses at 140° Fahr., attains its greatest fluidity at about 160°, and begins to boil at 250°. It distils without apparent decomposition, the colourless oil which passes over concreting as it cools into a colourless unctuous mass. As it distils, however, the boiling point of the residue rises very considerably, and it becomes darker coloured. Boiled in a retort with water, it is also volatilized in small quantity, and floats like wax on the water which collects in the receiver. Heated over a lamp in a platinum spoon, it takes fire, and burns with a pale blue, surmounted by a white flame, having little smoke, and leaving no residue.

It undergoes no apparent change when boiled in concentrated nitric, muriatic or sulphuric acid. Alcohol, even absolute and boiling, dissolves it very sparingly. The solution is rendered milky by water; and by spontaneous evaporation, deposits the dissolved portion in white flocks. Ether, in the cold, dissolves about four fifths of the whole, giving a solution which, like the substance itself, is brown by transmitted light, and by reflected light exhibits the greenish opalescence, observable in the ozocerite of Moldavia. The solution, by spontaneous evaporation, deposits the dissolved portion in brown flocks, which, at 102° Fahr., melt into a yellow brown liquid. The mass, on cooling, presents the external characters of the original substance, but has less consistence and density. Its specific gravity is 0.885, and it melts at 102° Fahr. A further small portion of the brown undissolved matter is taken up by boiling ether and alcohol. Obtained by evap.

* It is found, according to Dr. Meyer, at the foot of the Carpathians near Slanik, beneath a bed of bituminous slate clay, in masses sometimes from 80 to 100 pounds weight. Not far from the locality are several layers of brown amber. It is associated with the gres bigarré, with rock salt, and with beds of coal.

oration from these solutions, this second portion is colourless, or of a pale yellow; has the appearance and consistency of wax, and melts at 136° Fahr.,—about 16 degrees lower than the fusing point of bees' wax. The remaining portion, which is almost insoluble in boiling alcohol and ether, has a dark brown colour, and the consistence of soft wax; its density is 0.965; it melts at 163° Fahr., and boils at a temperature above 500° Fahr. The vapour has a peculiar and slightly bituminous odour. It constitutes about one-sixth of the mineral mass.

As it occurs in nature, therefore, this substance contains at least three several compounds, agreeing in their difference to acids, but differing in physical properties and in their relations, especially to ether. The following table exhibits a comparative view of the properties of the mixed mineral—of its three constituent parts—of the specimens of fossil wax from Moldavia, examined by Schrotter and Malaguti—and of the substance obtained from it by the latter on distillation.

	How obtained, or where.	Colour.	Consistence.	Density.
I. Ozocerite (Schrotter).	Found native in Moldavia.	Brown.	Hard, brittle.	0.953 at 15° C.
II. Ditto A. (Malaguti).	Ditto.	Ditto.	Ditto.	0.946 at 20.50.
B.	By distilling A.	0.	Of wax.	0.904 at 17° C.
III. Do. from Urpeth. A.	Urpeth Colliery.	Brown.	Of tallow.	
B.	From A. by cold ether.	Ditto.	Ditto.	0.885
C.	From residue, by boiling ether.	Yellow.	Of soft wax.	?
D.	Residue after boiling A in ether.	Dark brown.	Of wax.	0.955

The fossil wax examined by Magnus, seems to have been identical with that of Malaguti, only it melted at 82° C.

The inspection of this table shows that these mineral products contain at least four substances, possessed of different properties, chemical and physical, of which three are present in that from Urpeth Colliery.

1. One charged by sulphuric acid and insoluble in ether.—(*II. Malaguti.*)
2. One soluble in cold ether.—(*I. and II. B.*)
3. One soluble in boiling ether, and sparingly in boiling alcohol.—(*II. B. III. C.*)
4. A residual portion of greater density scarcely acted on by either of these menstrua.—(*III. D.*)

The different substances composing the ozocerite appear, as I have already stated, to be identical in chemical constitution, being entirely composed of carbon and hydrogen, in the same proportions as in olefiant gas. That the substance from Urpeth Colliery contains no oxygen, is proved by its not affecting the lustre of potassium, when melted along with it. The carbon and hydrogen were ascertained by burning with oxide of copper.

1. 8.43 grs. of the crude mass, freed by fusion from adhering earthy matter, gave 10.69 grs. of water, or 1.187 grs. of hydrogen.
2. 5.47 grs. of the matter taken up by ether, gave 6.92 grs. of water or 0.77 grs. of hydrogen.

3. 5.84 grs. of the same gave 7.39 grs. of water and 18.32 grs. of carbonic acid.
4. 5.47 grs. of the same gave 6.72 grs. of water and 16.58 grs. of carbonic acid.

Melts at	Boils at	In Ether.	Action of hot sulphuric acid.
62° C.=141.6° F.	210° C.=410° F.	Dissolves.	?
84° C.=182° F.	300° C.=572° F.	Almost insoluble.	Chars a portion of it.
56° to 57° C. = 133° to 134° F.	300° C.=572° F.	In boiling ether, very soluble.	?
60° C.=140° F.	121° C.=250° F.	Largely soluble.	0
39° C.=102° F.	?	Wholly soluble.	0
58° C.=136° F.	?	Soluble in boiling ether.	0
73° C.=163° F.	Above 260° C. =500° F.	Very sparingly soluble in boiling ether.	0

These results give for the crude mixed mineral, and for the portion soluble in ether, the same composition.

	1.	2.	3.	4.
Hydrogen,	14.09	14.07	14.06	13.649
Carbon,	85.81	85.83	86.80	83.812
	100	100	100.86	97.461

The ratio of the elements of the fourth analysis is that of atom to atom; the loss I attribute to the pumping out of a portion of the substance from the tube along with the moisture contained in the oxide of copper, the sand with which the tube was warmed in this experiment having been too hot for a substance boiling so low as 250° Fah.

The small portion of matter at my disposal prevented me from subjecting to analysis either of the other compounds contained in the crude mass; the composition of this mass, however, as exhibited in No. I, shows that these also must contain the elements in the same proportion as the matter actually analysed.

The following table shows also the identity, in chemical constitution, of these several substances, with the different varieties of Ozocerite from Moldavia.

	Atoms.	Equivalents.	Per cent. Calculated.	Ozocerite.			
				Magnus.	Schrotter.	Malaguti.	Fm. Urpeth.
Hydroge	1	12.479	14.0349	13.15	13.787	13.95	14.06
Carbon,	1	76.437	85.9651	85.75	86.204	86.07	86.80
		88.961	100.	98.86	99.991	100.02	100.86

The elementary composition of these different substances, therefore, is identical, and is the same as that of olefiant gas. The ozocerite found in Urpeth Colliery must have had its origin in the coal strata. Emitted, in the form of vapour, and carried along by the lighter gas (fire damp,) given

off at the same time, it would pass through the trouble, on its way to the surface, and be partly condensed in the cavities, and other cool places it came in contact with. It is highly probable that the other varieties of fossil wax may have been derived from a similar source.

In considering the inflammable and explosive substances existing in coal mines it is usual to limit the attention solely to the permanent gas given off, without adverting to the possibility of other substances of a volatile nature, being also emitted in the state of vapour. The occurrence of this variety of Ozocerite, in Urpeth Colliery, shows us that the light carburetted hydrogen sometimes carries along with it other volatile substances, and there is strong reason for believing that the combustible portion of the atmosphere of our coal mines rarely, if ever, consists wholly of this light gas. To show the Proteus-like character of the compounds of carbon and hydrogen, in the ratio of atom to atom, and how little chemical analysis can avail directly in determining the total absence of these substances, I subjoin a table, exhibiting the characteristic properties of the numerous bodies we are already acquainted with, in which the elements exist in this proportion.

	How obtained, or where.	State at 60 degrees.	Density.	Becomes solid or liquid at	Boils at	Density of gas or vapour.
Sweet oil of wine.	In preparing ether.	Oily liquid.	0.917	Solid at 31° F	536° F.	?
Solid oil of wine.	Ditto.	Prisms.	0.980	Liq. at 230°	500+	?
Solid oil of roses.	In oil of roses.	Crystalline plates.	?	Do. at 95°	536° to 572°	?
Paraffine.	From wood, coal, and animal tars.	Ditto.	0.87	1 ° to 111°	?	?
Naptha.	From natural wells, and from coal tar.	Liquid.	0.75 to 0.78	?	176° to 212°	2.833
Methylene.	Exists in wood spirit.	Gas.	0.4903	?	?	0.4903
Olefiant gas.	By heating alcohol with twice its bulk, of sulphuric acid.	Gas.	0.9806	?	?	0.9806
Faradays light liq	By compres'g oil gas.	Ditto.	1.9612	Liq. at 0°	Below 32°	1.9612
Cetene.	Distilling æthel with phosphoric acid.	Oily fluid.	?	?	527°	7.844
Elaene.	Distilling metaoleic and hydrolaic acids.	Ditto.		?	230°	4.488
Oleene.		Ditto.		?	131°	2.875 to 3.02
Hatchetine.	Found native.	Solid.	0,916	Liq. at 115°	?	?
Ozocerite.	Ditto.	Ditto.	0.885 to 0.955	Liq. from 102° to 182°	250° to 572°	?
Caoutchene.	Distill'g caoutchouc.	Liquid.	0.65 at	Liq. at 14°	58.2	?
Heveéne.	Do. or from caoutchouc by sulp. acid.	Dense do.	0.921 at	?	579°	?

A glance at the second column of this table shows that several of these substances are obtained from the products of the distillation of coal; and though it has not been *demonstrated* that any of them actually exist ready formed in the mass of the coal itself, yet the very low temperature at which some of them are given off lends to this opinion a considerable degree of probability. Richenbach states that bituminous coal by distillation with water, yields 1.320,000th of an æthereal oil, which is identical with native naphtha; and he concludes that the naphtha and petroleum springs of Persia, India, Italy, and South America, have their origin in the slow distillation of large beds of coal, by the ordinary heat of the earth. The fossil wax of Moldavia and the hatchetine of England, are probably derived from vegetable matter by a like agency.

Naphtha is a comparatively dense fluid, requiring a temperature of upwards of 173° Fahr. to boil it; and, therefore, unless present in large quantity, it will rarely escape from the coal so rapidly as alone to render the atmosphere combustible; but, suppose the very light liquid discovered in oil gas to exist in the coal, it will at once escape as a highly inflammable gas, and materially injure the atmosphere. Because such substances have not hitherto been observed in the air of mines, we ought not hastily to conclude that they do not exist, ready formed, in the great laboratory of nature. The difficulty of detecting them in a limited portion of gaseous matter will, probably, long present insuperable obstacles to the analytical chemist, while the more we learn of the carbo-hydrogens the more likely it appears that several of them should be occasionally present in the air which circulates through mines of bituminous coal.

The common fire damp requires, for its perfect combustion, ten times its bulk, the vapour of Faraday's light liquid thirty times, and that of naphtha forty-five times its bulk of common air. A very small portion of either of the latter, therefore, would render an atmosphere dangerous. The *sudden* outburst of a small reservoir would pollute a working previously considered safe, and give rise to an explosion where none was considered possible. In a district of country like the north of England, where rich bituminous coal is so abundant, where mines are worked at the very verge of the inflammable state, and where the most serious accidents from explosions *occasionally* occur, it is of importance, I think, that the probable presence of such substances, in the state of vapour, should be taken into account. Where the coal is richer than usual, and where troubles occur in which these compounds, as at Urpeth, may exist in a liquid or solid state, the rapid escape of combustible matter may be anticipated; while the probability of such escape affords a rational explanation of those sudden and unexpected emissions of gaseous matter which have occasionally been followed by consequences so disastrous.*

An observation familiar to practical men in the English coal fields leads to the same conclusion. In mines where candles or open lamps are used, it is by the appearance of the flame that the miner judges of the purity of the atmosphere, and the presence of combustible matter. When little inflammable gas is mixed with the air, the flame carries over it a very short pale blue *head*, which increases in length as the quantity of the carbo-hydrogen increases, until the whole atmosphere becomes one explosive mixture.

* Another explanation had previously been given by Mr. Hutton, in following up an idea originally suggested we believe by Dr. Paris; see L. and E. Phil. Mag. vol. ii. p. 303; and Parr's Life of Davy, p. 395. Both are probably true.—Edit.

But in different coal fields, the length of *head,* as it is called, which indicates an approach to the explosive state, is very different. In the Newcastle and Leeds coal fields 1½ inches indicate danger; in S. Wales 4 or 5 in. are not unusual. The colour of the head is also a criterion by which the miner judges; when blue, combustible matter is present, and an explosion is to be feared; if brown and muddy, carbonic acid is suspected, and the danger is less.

Though no *particular* conclusions can be drawn from these observations, yet the general result does force itself upon us, that the various compounds of carbon are at different times present in the atmosphere of coal mines in various quantities; and that sudden explosions may often be caused by the escape from cavities in the coal strata of other compounds than that usually called the fire damp, and to which all the mischief is usually attributed.

Durham, March, 1838.

Note.—I have just seen in the possession of Prof. Graham, of University College, a candle formed of a substance said to be found in considerable quantities in the coal mines near Linlithgow in Scotland. It resembles in every respect the Ozocerite candles of Moldavia. The substance is dull brown, and after fusion almost black, reflected and reddish brown by transmitted light; mass opake but translucent at the edges and in thin layers; is greasy to the touch (like Hatchetine,) easily scratched by the nail, has a conchoidal fracture, and when cold has no perceptible smell.

I may here mention also that the Middletonite described in a former paper, has since been met with in the mass of the coal in the Newcastle coal field. May not this substance be the resin of the trees of the carboniferous æra more or less changed.—April 16.

Lond. & Edin. Philos. Mag.

Electrical Induction.

Dr. Faraday in his last series of "experimental researches in Electricity," (eleventh series) thus expresses his opinion of the actual condition and importance of this department of science.

"The science of electricity is in that state in which every part of it requires experimental investigation; not merely for the discovery of new effects, but, what is just now of far more importance, the development of the means by which the old effects are produced, and the consequent more accurate determination of the first principles of action of this most extraordinary and universal power in nature:—and to those philosophers who pursue the inquiry zealously yet cautiously, combining experiment with analogy, suspicious of their pre-conceived notions, paying more respect to a fact than a theory, not too hasty to generalize, and, above all things, willing at every step to cross-examine their own opinions, both by reasoning and experiment, no branch of knowledge can afford so fine and ready a field for discovery as this. Such is most abundantly shown to be the case by the progress which electricity has made in the last thirty years: Chemistry and Magnetism have successively acknowledged its overruling influence; and it is probable that every effect depending upon the powers of inorganic matter, and perhaps most of those related to vegetable and animal life, will ultimately be found subordinate to it."

The true theory of electrical action appears to be absolutely dependent on a knowledge of the nature of Induction. To this, therefore, he has directed, almost exclusively, his recent experimental researches.

"Amongst the actions of different kinds into which electricity has con-

ventionally been subdivided, there is, I think, none which excels, or even equals in importance that called *Induction*. It is of the most general influence in electrical phenomena, appearing to be concerned in every one of them, and has in reality the character of a first, essential, and fundamental principle. Its comprehension is so important, that I think we cannot proceed much further in the investigation of the laws of electricity without a more thorough understanding of its nature; how otherwise can we hope to comprehend the harmony and even unity of action which doubtless governs electrical excitement by friction, by chemical means, by heat, by magnetic influence, by evaporation, and even by the living being?

In the long-continued course of experimental inquiry in which I have been engaged, this general result has pressed upon me constantly, namely, the necessity of admitting two forces, or two forms, or directions of a force, (516. 517.), combined with the impossibility of separating these two forces (or electricities) from each other, either in the phenomena of statical electricity, or those of the current. In association with this, the impossibility under any circumstances, as yet, of absolutely charging matter of any kind with one or the other electricity, dwelt on my mind, and made me wish and search for a clearer view than any I was acquainted with, of the way in which electrical powers and the particles of matter are related; especially in inductive actions, upon which almost all others appeared to rest.

When I discovered the general fact that electrolytes refused to yield their elements to a current when in the solid state, though they gave them forth freely if in the liquid condition (380. 394. 402.) I thought I saw an opening to the elucidation of inductive action, and the possible subjugation of many dissimilar phenomena to one law. For let the electrolyte be water, a plate of ice being coated with platina foil on its two surfaces, and these coatings connected with any continued source of the two electrical powers, the ice will charge like a Leyden arrangement, presenting a case of common induction, but no current will pass. If the ice be liquefied, the induction will fall to a certain degree, because a current can now pass; but its passing is dependent upon a *peculiar molecular arrangement* of the particles consistent with the transfer of the elements of the electrolyte in opposite directions, the degree of discharge and the quantity of elements evolved being exactly proportioned to each other (377. 783.) Whether the charging of the metallic coating be effected by a powerful electrical machine, a strong and large voltaic battery, or a single pair of plates, makes no difference in the principle, but only in the degree of action (360.) Common induction takes place in each case if the electrolyte be solid, or if fluid, chemical action and decomposition ensue, providing opposite actions do not interfere; and it is of high importance occasionally thus to compare effects in their extreme degrees, for the purpose of enabling us to comprehend the nature of an action in its weak state, which may be only sufficiently evident to us in its stronger condition. As, therefore, in the electrolyte, *induction* appeared to be the *first* step, and *decomposition* the *second* (the power of separating these steps from each other by giving the solid or fluid condition being in our hands); as the induction was the same in its nature as that through air, glass, wax, &c., produced by any of the ordinary means; and as the whole effect in the electrolyte appeared to be an action of the particles thrown into a peculiar or polarized state, I was led to suspect that common induction itself was in all cases an *action of contiguous particles*, and that electrical action at a distance (i. e. ordinary inductive action) never occurred except through the intermediate influence of the intervening matter.

The respect which I entertain towards the names of Epinus, Cavendish, Poisson, and other most eminent men, all of whose theories I believe consider induction as an action at a distance and in straight lines, long indisposed me to the view I have just stated; and though I always watched for opportunities to prove the opposite opinion, and made such experiments occasionally as seemed to bear directly on the point, as, for instance, the examination of electrolytes, solid and fluid, whilst under induction by polarized light (951. 955.), it is only of late, and by degrees, that the extreme generality of the subject has urged me still farther to extend my experiments and publish my view. At present I believe ordinary induction in all cases to be an action of contiguous particles, consisting in a species of polarity, instead of being an action of either particles or masses at sensible distances: and if this be true, the distinction and establishment of such a truth must be of the greatest consequence to our further progress in the investigation of the nature of electric forces. The linked condition of electrical induction with chemical decomposition, of voltaic excitement with chemical action; the transfer of elements in an electrolyte; the original cause of excitement in all cases; the nature and relation of conduction and insulation; of the direct and lateral, or transverse, action constituting electricity and magnetism; with many other things more or less incomprehensible at present, would all be affected by it, and perhaps receive a full explication in their reduction under one general law.

I searched for an unexceptionable test of my view, not merely in the accordance of known facts with it, but in the consequences which would flow from it if true; especially in those which would not be consistent with the theory of action at a distance. Such a consequence seemed to me to present itself in the direction in which inductive action could be exerted. If in straight lines only, though not perhaps decisive, it would be against my view, if in curved lines also, that would be a natural result of the action of contiguous particles, but I think utterly incompatible with action at a distance, as assumed by the received theories, which, according to every fact and analogy we are acquainted with, is always in straight lines.

Again, if induction be an action of contiguous particles, and also the first step in the process of electrolyzation (1164. 949.), there seemed reason to expect some particular relation of it to the different kinds of matter through which it would be exerted, or something equivalent to a specific electric induction for different bodies, which, if it existed, would unequivocally prove the dependence of induction on the particles; and though this, in the theory of Poisson and others, has never been supposed to be the case, I was soon led to doubt the received opinion, and have taken great pains in subjecting this matter to close experimental examination.

Another ever-present question on my mind has been, whether electricity has an actual and independent existence as a fluid, or fluids, or was a mere power of matter, like what we conceive of the attraction of gravitation. If determined either way it would be an enormous advance in our knowledge; and as having the most direct and influential bearing on my notions, I have always sought for experiments which would in any way tend to elucidate that great question. It was in attempts to prove the existence of electricity separate from matter, by giving an independent charge of either positive or negative power to some substance, and the utter failure of all such attempts, whatever substance was used or whatever means of exciting or *evolving* electricity were employed, that first drove me to look upon induction as an action of the particles of matter, each having *both* forces devel-

oped in it in exactly equal amount. It is this circumstance, in connexion with others, which makes me desirous of placing the remarks on absolute charge first, in the order of proof and argument, which I am about to adduce in favour of my view, that electric induction is an action of the contiguous particles of the insulating medium or *di-electric.*

Can matter, either conducting or non-conducting, be charged with one electric force independently of the other, in the least degree, either in a sensible, or a latent state?

The beautiful experiments of Coulomb upon the equality of action of *conductors*, whatever their substance, and the residence of *all* the electricity upon their surfaces,* are sufficient, if properly viewed, to prove that *conductors cannot be bodily charged;* and as yet no means of communicating electricity to a conductor so as to relate its particles to one electricity, and not at the same time to the other in exactly equal amount, has been discovered.

With regard to electrics or non-conductors, the conclusion does not at first seem so clear. They may easily be electrified bodily, either by communication (1247.) or excitement; but being so charged, every case in succession, when examined, came out to be a case of induction, and not of absolute charge. Thus, glass within conductors could easily have parts not in contact with the conductor brought into an excited state; but it was always found that a portion of the inner surface of the conductor was in an opposite and equivalent state, or that another part of the glass itself was in an equally opposite state, an *inductive* charge and not an *absolute* charge having been acquired.

Well purified oil of turpentine, which I find to be an excellent liquid insulator for most purposes, was put into a metallic vessel, and, being insulated, was charged, sometimes by contact of the metal with the electrical machine, and at others by a wire dipping into the fluid within; but whatever the mode of communication, no electricity of one kind was retained by the arrangement, except what appeared on the exterior surface of the metal, that portion being there only by an inductive action through the air around. When the oil of turpentine was confined in glass vessels, there were at first some appearances as if the fluid did not receive an absolute charge of electricity from the charging wire, but these were quickly reduced to cases of common induction jointly through the fluid, the glass, and the surrounding air.

I carried these experiments on with air to a very great extent. I had a chamber built, being a cube of twelve feet in the side. A slight cubical wooden frame was constructed, and copper wire passed along and across it in various directions, so as to make the sides a large net-work, and then all was covered in with paper, placed in close connexion with the wires, and supplied in every direction with bands of tinfoil, that the whole might be brought into good metallic communication, and rendered a free conductor in every part. This chamber was insulated in the lecture-room of the Royal Institution; a glass tube above six feet in length was passed through its side, leaving about four feet within and two feet on the outside, and through this a wire passed from the large electrical machine (290.) to the air within. By working the machine, the air within this chamber could be brought into what is considered a highly electrified state (being, in fact, the same state as that of the air of a room in which a powerful machine is in operation,)

* Memoires de l'Academie, 1786, pp. 67, 69, 72; 1787, p. 452.

and at the same time the outside of the insulated cube was everywhere strongly charged. But putting the chamber in communication with the perfect discharging train described in a former series (292.), and working the machine so as to bring the air within to its utmost degree of charge, if I quickly cut off the connexion with the machine, and at the same moment, or instantly after, insulated the cube, the air within had not the least power to communicate a further charge to it. If any portion of the air was electrified, as glass or other insulators may be charged (1171.) it was accompanied by a corresponding opposite action *within* the cube, the whole effect being merely a case of induction. Every attempt to charge air bodily and independently with the least portion of either electricity failed.

I put a delicate gold-leaf electrometer within the cube, and then charged the whole by an *outside* communication, very strongly, for some time togegether; but neither during the charge or after the discharge did the electrometer, or the air within, show the least signs of electricity. I charged and discharged the whole arrangement in various ways, but in no case could I obtain the least indication of an absolute charge; or of one by induction in which the electricity of one kind had the smallest superiority in quantity over the other. I went into the cube and lived in it, and using lighted candles, electrometers, and all other tests of electrical states, I could not find the least influence upon them, or indication of anything particular given by them, though all the time the outside of the cube was powerfully charged, and large sparks and brushes were darting off from every part of its outer surface. The conclusion I have come to is, that non-conductors, as well as conductors, have never yet had an absolute and independent charge of one electricity communicated to them, and that to all appearance such a state of matter is impossible.

There is another view of this question which may be taken under the supposition of the existence of an electric fluid, or fluids. It may be impossible to have the one fluid, or state, in a free condition without its producing by induction the other, and yet possible to have cases in which an isolated portion of matter in one condition being uncharged, shall, by a change of state, evolve one electricity or the other; and though such evolved electricity might immediately induce the opposite state in its neighbourhood, yet the mere evolution of one electricity without the other in the *first instance*, would be a very important fact in the theory which assumes a fluid or fluids; these theories, as I understand them, not assigning the slightest reason why such an effect should not occur.

But on searching for such cases I cannot find one. Evolution by friction, as is well known, gives both powers in equal proportion. So does evolution by chemical action, notwithstanding the great diversity of bodies which may be employed, and the enormous quantity of electricity which can in this manner be evolved (371. 376. 861. 868.) The more promising cases of change of state, whether by evaporation, fusion, or the reverse processes, still give both forms of the power in *equal* proportion; and the cases of splitting of mica and other crystals, the breaking of sulphur, &c. &c., are subject to the same limitation.

As far as experiment has proceeded, it appears, therefore, impossible either to evolve, or make disappear, one electric force without equal and corresponding change in the other. It is also equally impossible experimentally to charge a portion of matter with one electric force independently of the other. Charge always implies *induction*, for it can in no instance be effected without; and also the presence of the *two* forms of power, equally

at the moment of development and afterwards. There is no *absolute* charge of matter with one fluid; no latency of a single electricity. This, though a negative result, is an exceedingly important one, being probably the consequence of a natural impossibility, which will become clear to us when we understand the true condition and theory of the electric power.

The preceding considerations already point to the following conclusions: bodies cannot be charged absolutely, but only relatively, and by a principle which is the same with that of *induction*. All *charge* is sustained by induction. All phenomena of *intensity* include the principle of induction. All *excitation* is dependent on, or directly related to, induction. All *currents* involve previous intensity and therefore previous induction. INDUCTION appears to be the essential function both in the first development, and the consequent phenomena, of electricity.

The electrometer and inductive apparatus employed will be found described in the (R. S.) Philosophical Transactions for 1838, part I, and in the Lond. & Ed. Phil. Mag. for October, 1838.

Meteorology.—Meeting of the British Association.

Dr. Daubeny read a paper "On the Climate of North America."

The Doctor began by observing, that although the general fact was admitted that the eastern portion of the New World possessed a lower temperature than the western portion of the Old, yet that much remains to be done before the relative climate of these two portions of the globe can be regarded as in any degree determined. In proof of this, he exhibited a table, in which he had entered a series of all the mean temperatures of different places in North America, which he had been able from various sources to collect, and showed that the greater part of them were very little to be relied upon as to accuracy. In Canada, the best observations yet made were those by McCord, of Montreal; and, in the United States, those communicated by the Regents of the University of the State of New York, with respect to the mean temperature of no less than thirty-three places within the state, where academies supported at the public expense are established. But the observations are likewise defective, in not taking any account of the intensity of solar radiation, which probably affects the distribution of plants and animals in a manner which is quite distinct from its accompanying temperature. Hence, though many plants which grow in this country are killed by the winters of comparatively southern latitudes in America; yet others, which require the warmth of a wall or of a southern aspect here, are found in comparatively high latitudes in the New World. But though the observations yet made are so imperfect, there seems no want of disposition either in Canada or in the United States to contribute to the advancement of meteorology, and to adopt the suggestions of European philosophers on this subject, as is evidenced by the promptitude with which Sir John Herschel's suggestions, with respect to hourly observations on certain days, have been acted on in both countries; and, hence, Dr. Daubeny suggested that it would be likely to contribute much to the advancement of this science, if the Association were to circulate extensively in the United States instructions both as to the use of meteorological instruments, and as to the proper hours for observing; and if they were to present to three or four public institutions

in Upper and Lower Canada sets of the instruments deemed most important, carefully compared with each other, or with a uniform standard.

Sir John Herschel said, that of all the sciences which now engross the attention of the thinking part of mankind, none required a greater union of exertion than meteorology; in fact, from want of attention to this, there was no science in the pursuit of which so much time and labour had been thrown away. In it, union might emphatically be said to be strength, while mere individual exertion was little better than inaction. With this conviction, he had some time since ventured to propose that meteorological observations, continued through the twenty-four hours, should be made simultaneously in all parts of the globe. He was happy to say, that, in conformity with this suggestion, he had received numerous communications, giving the observations made at widely distant stations on the appointed days; and to none had he to express his obligations in stronger terms than to the philosophers of the United States of America. In some, however, of the most valuable meteorological registers, he found the hours of observation selected were those only of the day. Now, he was aware of the great additional labour required for night observations, and that nothing but zeal of a high-philosopher-power could enable observers, for any length of time, to pursue such observations; but when he considered the importance of these registers to the science, he could not but press the practice anxiously on public attention. The results of these night observations would be found to differ very widely, and often most materially, from those of day; the fluctuations of the barometer were different, the formation and dispersion of clouds and the falling of rain, all followed different laws by night from those which by day controlled their courses.—Sir David Brewster called attention to the important fact, clearly established by the meteorological observations recorded in the neighbourhood of New York, and those of Hansteen and Erman in Siberia, that two points of maximum cold existed in these regions, very generally agreeing in position with the centres of maximum magnetic intensities; and like them, too, the maximum of N. America indicated a decidedly higher degree of cold than that which characterized the Siberian pole. Also, that the lines of equal mean temperature, as they surround these poles, had such a relation to the lines of equal magnetic intensity, as to point out clearly some yet unknown connexion between these two classes of phenomena. The same gentleman who addressed the Section at the close of Mr. Whewell's paper, said, that he could not agree to some of the conclusions at which Dr. Daubeny had arrived. As to the connexion between animal and vegetable life and climate, something more would be found necessary than mere mean temperature. He had often ridden violently and used much bodily exertion in New South Wales, with the thermometer at 110° in the shade, when the same temperature in England would be insupportable; and in the East Indies all Europeans were so enervated when the thermometer stood at this height, as to be nearly incapable of active exertion. As to vegetation, we had on the one side of the Himalayan range, at an elevation of little more than 10,000 feet, lichens, and all the stunted vegetation of the polar regions; while, on the other side, at an elevation of nearly 16,000 feet, we had corn fields and large forest trees, and all the productions of temperate regions of the earth. Nor could he agree in Dr. Daubeny's conclusion, that the mean temperature to the west of the Alleghany mountains was much lower in North America than to the east. In his opinion, the contrary was the fact in many parts west of the Rocky mountains. In California, and along the Columbia river, were found large cedars and other productions of coun-

tries bordering on tropical; while to the east, in the very same latitudes, could only be found lichens, and almost all other polar vegetables. In his opinion, the courses of rivers and of extensive forests, as well as the high ranges of mountainous tracts, were to be taken into account, as influencing, most materially the climate of the circumjacent territories. Dr. Daubeny explained that he had been misunderstood, if supposed to say that all places to the west of the Alleghany mountains were colder in their climate than those to the east, his observations had reference to the space included between the Alleghany and the Rocky ranges of mountains, or what is in part called the valley of the Mississippi, compared with the more eastwardly portion of North America. With many of the other observations of the gentleman he concurred, nor was he aware that they were opposed to any of the statements comprised in his very brief notice of the climate of North America. Prof. Bache, of Philadelphia, made some remarks on the importance of connecting the observations making in the United States, with any which the British Association might institute in the colonies of Britain in North America. Considerable progress, he said, had, within a few years, been made in America in the science of meteorology. The abstracts of the reports of meteorological observations from the academies of the state of New York, and the deductions made from them by Sir David Brewster, had been a great stimulus to increased activity in that department. The recommendations of Sir John Herschel had not only been adopted by individuals, but had led to the formation of societies for the cultivation of meteorology. These, independently of other facts, convinced him that he hazarded nothing in promising the hearty concurrence of meteorologists in the United States in any extensive plan which the British Association should sanction.

Brit. Assoc.—Athenæum.

On Professor EHRENBERG AND HAUSMANN'S *Discoveries regarding two varieties of Siliceous Earth found near Oberohe in the Hanoverain Province of Lüneberg.*

On the 8th January 1838, Professor Hausmann communicated to the Royal Society of Sciences of Göttingen, a preliminary notice, on a discovery connected with our own country, which is undoubtedly among the most remarkable facts lately added to the science of geognosy.

In the month of November this year, Colonel von Hammerstein, President of the Provincial Agricultural Society at Uelzen, in the territory of Lüneberg, the able author of several prize essays, and the zealous promoter of the agriculture of his native country, had the goodness to send to Professor Hausmann two specimens of varieties of earth, which were dug out near Oberohe during an excavation made by the abovementioned society in the district of Ebstorf. The extreme lightness of these varieties of earth rendered it improbable that they were of an argillaceous nature; but their state of aggregation did not permit us to conclude that they consisted of pure silica, although, notwithstanding this, they really have such a composition, according to the chemical examination kindly instituted by Dr. Wigners in the academical laboratory. The specimen No. 1, according to this investigation, is chemically *pure silica.* It has, at the same time, a fine, extremely loose, earthy, flaky consistence, and a chalk white colour. It has a soft and meagre feeling, somewhat like starch, and does not grate between the teeth. On water

it swims for a moment, then sinks down, and gradually swells up. Mixed with a little water, it acquires a pasty consistence, without being adhesive. The specimen No. 2. is also silica, but contains likewise a very insignificant quantity of a matter destructible by fire. Its fracture is fine-earthy; the colour brownish-grey, slightly inclining to green, becoming darker by the addition of moisture. It is friable, meagre, but soft to the touch, and adheres to the tongue. It swims on water for some minutes, but it afterwards sinks, absorbing water with a noise, giving out many air-bubbles, and then expands gradually by irregular splitting of the laminæ, without being altogether separated. When exposed to heat, it rapidly assumed a white colour. Here and there it is traversed by veins of pure, chalk-white, fine-earthy, silica, filled with smaller or larger cavities.

According to the information communicated by Colonel von Hammerstein to Professor Hausmann, this silica has been found in astonishing quantity in six different places of the above-mentioned district, on the edge and first acclivity of the great plateau of the *Lüneburger Haide*, covered to the depth of only one foot and a half by the soil. The pure white silica forms the upper bed, and has a thickness of 10 feet to 18 feet. The coloured portion is beneath, and has been already penetrated to a depth of 10 feet, without the lower boundary having been reached.

The peculiar state of aggregation of this silica led Professor Hausmann to conjecture that it might be analogous to the *Kieselguhr* found in the turf at Franzensbad in Bohemia, and that like that substance, it might be composed of the siliceous shields of infusory animals. A preliminary microscopic examination seemed to confirm this notion. In order to attain certainty on this subject, Professor Hausmann sent specimens to the distinguished investigator of the infusory world, Professor Ehrenberg of Berlin, who, by his extraordinary discoveries regarding the occurrence of fossil infusoria, has opened an entirely new field of the most interesting investigations. He requested that naturalist to examine these specimens of earth more minutely, with a special view to these objects, and he received, through his kindness, the intelligence, that *both earths are entirely composed of beautiful and perfectly preserved infusory coverings;* that these are very various, but still belong only to known species, and to such as are found in a living state in fresh water at the present day. In the earth No. 1 they are free from foreign admixture; but in No. 2 they are mixed with organic slime, and with the pollen of pines. During even his first examination, Professor Ehrenberg succeeded in determining several species of infusoria, whose coverings form this silica, and in ascertaining that there occurs, in the lower bed, a species of infusoria found in the polishing slate of Habichtswald and Hungary; and another peculiar to the *Kieselguhr* of Bohemia; both of which seem to be entirely wanting in the upper bed: but upon these points we shall defer further remarks, in order that we may not anticipate the publication of the completed investigation of Professor Ehrenberg.

That a mass more than twenty feet in thickness should consist almost entirely of the coverings of animals which are invisible to the naked eye and which can only be recognised with the assistance of a high magnifying power, is an extraordinary fact, and one which the mind cannot fully comprehend without some difficulty. The farther we attempt to pursue the subject the more we are astonished. That which occurs in an invisible condition in the fluid element, and which cannot be recognised by the human senses without the assistance of art, becomes, by

immense accumulation and solidification, one of the circle of phenomena which are witnessed by us in the ordinary way; a compact mass is formed, which can be weighed, felt, and seen; and this mass is presented to us in such quantity, that, when regarded only in *one* direction, it surpasses by three times the height of the human figure. Who could venture to calculate the number of infusory animals which would be required to produce even one cubic inch of this mass? And who could venture to determine the number of centuries during which the accumulation of a bed of twenty feet in thickness was taking place? And yet this mass is only the product of yesterday compared with the other more compact siliceous masses for which the infusoria of a destroyed creation afforded materials. But what would have become of that loose, light silica,—which, by its great porosity and its power of absorbing water in quantity, in some measure indicates its origin,—if, instead of being covered by soil one foot and a half in thickness, it had been covered by a great mass of earth or rock; or if another power, such as the action of fire, had caused its solidification? In that case, we should have had no bed twenty feet in thickness, but should perhaps have found a compact stony mass, capable of scratching glass, affording sparks with steel, and polishable,—a substance, which, were it not for the abundant evidence furnished by the discoveries of Ehrenberg, it would be still more difficult to suppose had resulted from the coverings of invisible animals. Such a consolidation and hardening of this loose silica, might perhaps be partly accomplished in another way, by making the experiment of employing it for the manufacture of glass, or as one of the ingredients in porcelain; by which means a discovery so very remarkable in a natural historical point of view might at the same time become of practical importance. *Glass formed from the coverings of infusory animals!* Who would a few years ago have believed in the possibility of this substance, by whose assistance invisible life in water is revealed to us, being prepared from a material derived from the same world of extremely minute animated beings; or that we should be enabled, by means of a substance furnished by an invisible creature, to investigate the smallest and most obscure, as well as the largest and most remote, bodies in creation?—(Communicated to us by Professor Hausmann from the "*Göttingische gelehrte anzeigen*," 25th January, 1838.) Ed. Philos. Journal.

An additional interest is given to the foregoing statement by the fact that a deposit of these infusorial coverings, analogous to that above described, has been discovered by Professor J. W. Bailey of West Point, N. Y.; and they doubtless will be found in no inconsiderable extent in other parts of this country. Professor Bailey says the deposit he discovered is "8 or 10 inches thick and probably several hundred yards in extent, which is wholly made up of the siliceous shells of the Bacillaria, &c., in a fossil state;" v. his paper with figured descriptions in Silliman's Journal, October, 1838. We have examined a portion of this "clay coloured mass" from West Point, under the microscope, and witnessed the organic forms as described by the discoverer. G.

Relations of Light Heat, and Electricity.—By M. Becquerel.

If we inquire concerning the relations which exist between the production of heat and the production of electricity, in the mutual friction

of two bodies, the following are the consequences which result from the experiments which have been recently made. The displacement of parts of the rubbed surfaces always occasions a disengagement of heat and a disengagement of electricity,—two effects which exert a mutual dependence. This dependence, however, is so much obscured, that it is still impossible to affirm if the one precedes the other, or *vice versa.* We can only make conjectures on this point,—conjectures which go to shew that the heat is derived from the electricity, when the bodies are of the same nature,—are bad conductors of caloric,—and only differ as to the condition of their surfaces. The surface which is most heated becomes negatively electrified; and that which is least heated positively. When the bodies are different, the effects become more complex, and can be interpreted only when the results are immediately under observation.

Some facts recently brought under review permit us to group together the relations discovered between heat and electricity, and of which phosphorescence supplies an example. It is known that this phenomenon shews itself wherever particles of bodies which are bad conductors of electricity are disturbed by percussion, friction, heat, light, a shock of electricity, or when they are decomposed by chemical action. These causes are precisely those which likewise disengage electricity; and the phenomena being atomic, must produce an infinite number of minute sparks, which together produce a faint light similar to phosphorescence. Hence we may suppose that phosphorescence has an electrical origin.

In glow-worms *(Lampyris)* and the infusoria, we are ignorant whence the phosphorescence proceeds, and whether it be owing to electricity. The important experiments, however, of M. Ehrenberg are about to instruct us. This able physiologist has lately been studying with peculiar care the light which is emitted in darkness by the infusoria and the annelides which make the ocean luminous in certain countries, especially when its surface is agitated by a gentle breeze. Having placed on the object-glass of his microscope, water containing these animalcula, he was exceedingly astonished to perceive, that the diffused glimmer which surrounded them was nothing else than a collection of a vast number of small sparks which came from every part of their bodies, and particularly from the bodies of the annelides. These sparks, which succeeded each other with great rapidity, had such a resemblance with those we observe in common electrical discharges, that M. Ehrenberg does not hesitate to conclude that they are identical. He has also satisfied himself that the light emitted is not owing to a particular secretion, but solely to a voluntary act of the animalcule, and that it shews itself as often as it is irritated by mechanical or chemical means, that is to say, by agitating the water, or throwing either alcohol or acid into it. This is an additional analogy with the torpedo, which only gives a discharge when irritated. In the animalcula, as in the torpedo, it is also observed that the discharge recommences after a certain time of repose. From this similarity of effects, in the same circumstances, may we not infer an identity as to the causes? Now, in the torpedo, it is already known, and no one longer doubts it is electricity; and, hence, we must admit that electricity is also the cause which produces the phosphorescence of the infusoria and the annelides. It is sufficiently remarkable that the luminous or other phenomena which depend upon electricity are so much the stronger in proportion as the animals are smaller; and it would appear that this profusion of the electrical fluid, which is emitted only by

beings of an inferior order, is destined to discharge other functions in beings of a higher order.

Is it not, after this, allowable to imagine, as M. Berzelius and other philosophers have advanced, that the light which is disengaged by combustion, and which occasions so great a disengagement of electricity, is, also, nothing more than the result of the discharge of an infinite number of small sparks produced in the combination of combustible with other burning bodies?

We perceive, therefore, that the relations which associate together light, heat, and electricity, acquire from day to day additional extension, and demonstrate that these three agents which rule in the atomic constitution of bodies, are derived, according to all appearances, from a single principle of an ethereal nature, spread throughout space and through all bodies.

Ed. Philos. Journal.

Mechanics' Register.

List of American Patents which issued in February, 1838.

With Remarks and Exemplifications by the Editor.

43. For an improvement in *Propelling Steam Vessels;* John Ericsson, a subject of the kingdom of Sweden, now residing in Great Britain, February 1.

"This invention consists of two broad, metallic hoops, or short cylinders, supported by spiral arms, or spokes, and made to revolve in contrary directions, but at different velocities from each other, round a common centre; such hoops, or cylinders, being also placed entirely under the water at the stern of the boat, and furnished each with a short spiral plate; the plates of each series standing in at an angle the exact converse of the angle given to those in the other series, and kept revolving by the power of a steam engine, whereby a steam-boat may be propelled effectually, notwithstanding any variation in the draught of water."

Such is the announcement of the nature of the invention; after describing which, by references to drawings, the patentee says, "Now, whereas the use of spiral wheels acting obliquely against the water, and moving in contrary directions for propelling steam-boats is not new, I do not claim as my invention the use of such spiral planes, or their contrary motion; but I claim as my invention the metallic hoops, or cylinders, and the spiral arms, or spokes, hereinbefore described, together with the entire immersion of the propeller, by which means I am enabled to employ all the spiral plates at one time, and thereby the beneficial result of a great propelling force will be obtained by a propeller of much less dimensions than heretofore. And, I also claim as my invention, the giving a greater speed to the outer series of spiral plates, which move in the current produced by the motion of the other series, and by which greater speed the beneficial result of saving of power, and increased propelling force will be obtained.

"And I further claim as my invention, the application of the propeller, as described in drawing No. 2, that is to say, *First.* I claim the upright hollow

stern, with its arms, or hollow branches for carrying the propeller, by means of which stern the propeller may be either suspended, and immersed under the water when required to be used, or, on other occasions, lifted out of the water, so as not to interfere with the sailing of the vessel. *Secondly.* I claim the drum, or conical casing for protecting the bevil wheels, and for diminishing the resistance in passing through the water. *Thirdly.* I claim the attaching the propeller to, or detaching it from, the engine, or other power employed on board the vessel, by means of a coupling box at the upper end of the upright shaft of the bevil wheels."

The foregoing will afford a good general idea of the nature of the thing patented; its actual utility is, of course, to be decided by experience; the accounts of its trial abroad, so far as they have been carried, have been satisfactory; this, however, proves but little, as the same might be said of numerous inventions of which we never hear again; appearances, nevertheless, are certainly in its favour. It may be doubted whether the claim made to "the entire immersion of the propeller," can be sustained; spiral wheels, and segments, and also some revolving paddles, have been entirely immersed; but if this claim be considered as limited to the entire immersion of the wheels attached as described, the objection might be removed.

Wheels of this kind, entirely submerged, were probably first essayed in this country. The late Col. Stevens of Hoboken, New York, in the year 1805, informed the writer that he had tried such wheels in the stern of a boat, first using a single wheel in the centre. The tendency of the boat so tried, was to move in a circle; a result due to the lessened resistance, as the vanes rose towards the surface, in consequence of the greater ease with which the water was removed out of the way. Subsequently, two such wheels were tried, side by side, revolving in reversed directions; but the effect not being deemed equal to that which had been hoped for, the thing was abandoned. In the present instance, the shaft of one wheel is a tube, through which that of the other wheel passes, one of the two wheels, therefore, revolving immediately in front of the other; an arrangement which appears likely to be productive of much advantage.

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44. For an improvement in *Pumps;* Joseph Smart, Easton, Northampton county, Pennsylvania, February 3.

This is a double-acting, forcing pump, in which the improvement claimed consists in the inserting of the lower valves in such a manner as that they may be readily removed for repair, without disturbing the other parts of the pump, and without the necessity of working down in the well. One of the lower valve seats is covered with a cap, which may be removed to get at the valve; the other lower valve seat is immediately under the main cylinder, and we do not see in what way this is to be come at more handily than in many other pumps; the claim, however, is confined to the one with the cap.

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45. For an improvement in the *Saw for sawing Ice;* John Barker, Cambridge, Middlesex county, Massachusetts, February 3.

The claim under this patent is to "the peculiar formation and construction of the teeth of the saw," which is made with a handle fixed in the upper end, in the manner of the ordinary pit saw. The teeth are cut in with their upper and lower sides parallel to each other, and sloping towards the

front edge at an angle of about 45°. The space between two contiguous teeth is then sloped back, about an eighth of an inch, in a straight line, which regulates the depth of the cut of each tooth. The front edge is to be thickened, so as to cause the saw to run freely.

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46. For an improved Mill for *Breaking and crumbling lumps of Sugar;* William Bent, city of Philadelphia, February 3.

The sugar is to be put into a hopper beneath which there is a cylinder set round with a number of rows of iron teeth, which cylinder is to be turned by a winch, and the teeth thereon are to pass through slats, or openings, in an iron plate; as the sugar descends, it is operated upon in its passage between the cylinder and plate, and thus pulverized. The claim is to the "reducing of sugar by means of the aforesaid teeth, crushing it against the grating; whereas in the method heretofore used the machine for said purpose consists of two cylinders, of wood, or iron, set in frame work, and nearly in contact with each other, between which cylinders the sugar is passed by turning them with a crank, at great cost of labour."

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47. For an improved process of *Bating Hides and Skins;* Wm. Zollickoffer, Middlebury, Carroll County, Maryland, February 3.

(See Specification.)

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48. For improvements in the *Arrangement of Gearing for driving Machinery;* Jesse Urmy, Wilmington, Delaware, February 3.

The claim is to "the arrangement of an open mortise wheel for turning the two pinions placed inside of the same, in one direction, both acting on the centre pinion on the centre shaft, by means of the cog wheels on the pinion shafts, as described." The machine represented is that called a horse power. The "mortise wheel" is merely a wheel within the periphery of which two pinions revolve, on opposite points, for the purpose of equalizing the bearing of the main vertical shaft, on which the sweep is affixed. This, and a similar provision for equalizing the bearings, constitute the difference between this and some other horse powers.

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49. For an improvement in the method of *Constructing the Screw Arms of all kinds of planes regulated by Screw Arms;* Emanuel W. Carpenter, Lancaster, county of Lancaster, Pennsylvania, February 6.

Ploughs, fillisters, match planes, and others regulated by screw arms and nuts, are the subjects of this patent. The particular difference between this and similar instruments cannot be made known without a much longer description than the matter seems to merit. The claim is to the method as described in the specification. A plough has been deposited in the office as a model, exhibiting good workmanship on the part of the patentee.

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50. For an improvement in the *Power Loom;* Elijah Fairman, Stafford, Tolland county, Connecticut, February 6.

This is a kind of contrivance not to be made known in words alone, and

we can afford no other information therefore, than that general one which the claim will supply.

Claim.—"I claim the improvement of the application of an additional cam and a set of treadles; one cam operating on the harness in the usual manner, by moving it in one direction; my improvement of adding another set of treadles is for moving it in another situation, and for confining the harness by cords from the treadles, attached to both the upper and under side of the harness, instead of the upper side only, in the usual method. I also claim as my improvement the application of the additional cam to the long upright double treadles, and also the additional cords extending from the bottom or lower ends of said long treadles, to the under side of each harness."

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51. For improvements in the machine for *Making and twisting Strands in the process for making Rope;* Moses Day, Roxbury, Norfolk county, Massachusetts, February 7.

This patent is obtained for an improvement on a machine patented by the same person on the 2d day of June, 1836, of which we have not yet given an account, the records having been destroyed prior to our examination of that date. In the machine now patented, the apparatus is so arranged that the strands may be twisted, and the rope wound upon a bobbin, in an apartment no larger than is necessary to contain the machine. The flyer, containing the bobbin, revolves horizontally in a frame of wood, upon two centres which are hollow tubes. The strands pass from a bobbin frame opposite to one end of the machine, through a gauge plate, and thence through the hollow tube upon which that end of the flyer rests, and are twisted on their passage by the revolution of the flyer. On the end of the tube within the flyer, there is a bevil wheel, which gears into a bevil wheel on a shaft which crosses the flyer, and has its gudgeons in its two opposite sides. The rope passes two or three times round the shaft of this wheel, and thence to two guide pullies on one side of the shaft, which conduct it on to the bobbin.

The bobbin is placed upon a sliding shaft which passes through the tube that forms the back centre of the flyer, there being a suitable apparatus for giving it the reverse motion necessary to the winding of the rope, and the bobbin having the requisite friction on the shaft to cause the rope to be wound correctly. The claim made is to "the combination of the gauge plate with the flyer, constructed and operating substantially as described."

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52. For a *Remedy for Salt Rheum, &c.;* William B. Trufant, Bath, Lincoln county, Maine, February 10.

Since the new organization of the Patent Office the number of patents for medicines has been much diminished, as it is now considered to be the duty of the office to reject all applications where the composition proposed to be patented, is substantially the same with those known in the regular practice, or where the compound is of a kind which would render it one of special danger, if placed at the disposal of those who are unacquainted with its nature; and through this ordeal there are but few of the proposed remedies that can pass, and live. The demand of *novelty,* is one which the law makes in every case; this, therefore, is the ground upon which the first rule rests. The law

also requires *utility*, and although applications are not rejected because the utility is not apparent, as this might lead to unjust decisions, founded upon a mere matter of opinion, yet it has been decided in court, that the term useful is to be taken as contradistinguished from hurtful, or injurious, and that a man cannot, therefore, have a patent that would poison people, or would be otherwise injurious to the community; this, therefore, is the ground of the second rule, the propriety of which must be perfectly obvious, except by him to whom a patent is refused. The law is for "the promotion of the useful arts;" and that which does mischief cannot well come under this category.

It will be seen that notwithstanding all the care that the office can exercise, some despicable and worthless things must obtain the sanction of its seal, and it is believed that the medicines patented will be pre-eminently of this description; of this the public will have an opportunity of judging, as they will all be published, at full length, in this journal. The specification of the patent which has given rise to the foregoing remarks, will be found in the present number.

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53. For improvements in the machine for *Spreading lime, marl, and ashes on land, and exchanging soils*; Daniel T. Hill, Plainfield, Essex county, New Jersey, February 10.

This machine consists, mainly, of two cylinders, each formed of slats running longitudinally from one head of the cylinders to the other; these cylinders pass into each other, the inner being of a size to slide freely within the outer one; the number of slats in each is equal, and they have space between them about equal to the width of the slats. The outer cylinder may be turned upon the inner, and the spaces between the respective slats will thus be perfectly regulated. An axle passes through the inner cylinder, and has a wheel on each end, similar to a cart wheel, the axle running in bearings on a frame to which the horse is to be attached. There are openings for the purpose of admitting the manure, or other article, to be spread over the ground, and the operation of the whole must be perfectly apparent. The claim is to "the combination of two cylinders of slats, or rounds, and the mode of connecting them with the wheels, in the manner above described."

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54. For a mode of *Preserving Grass for Hay, &c.;* A. D. Ditmars, Chester county, Pennsylvania, February 15.

This patent is taken for forming air-tight bins, or boxes, in barns, &c., which are to be lined with sheet lead. The grass when cut, in dry weather, and free from dew, is to be placed in these receptacles, the lids fastened down, and the whole kept close until wanted in winter, when they are to be opened, and the grass used as feed. The claim is to "the preservation of grass for hay, by excluding it from the air in sheet lead, in the manner set forth."

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55. For an improvement in the *Straw Cutter;* Jonathan S. Eastman, city of Baltimore, February 15.

In this machine the straw is to be fed from a trough made in the usual manner, and the cutting is to be effected by means of a revolving knife, or knives, extending between two circular heads, the axis of which crosses the mouth of the trough. The claims made are to a particular mode of attach-

ing and detaching the hinder part of the box, for convenience of packing; to a double eccentric feeding apparatus, as combined with the other parts; and to an iron frame, described in the specification. These peculiarities, on which the claims rest, do not present any thing which changes the general character of the apparatus, or which requires particular notice. They are intended as improvements upon a machine of the same general character, for which a patent was obtained in the year 1822, and which is now, of course, public property.

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56. For an improvement in the *Machine for making Bricks*; J. Reeder, Cincinnati, Ohio, February 15.

A permanent, circular foundation of stone, or of wood, forty feet in diameter, is to be laid on the ground, and upon this a strong circular frame is to be fixed, on the face of which, and near to its periphery, the moulds are to be placed which are to receive the clay; these moulds are to be of iron, and the clay as it is dug from the bank is to be shoveled into them. A wheel, eight or ten feet in diameter, and weighing about three tons, is made to revolve over the moulds, it being connected by a horizontal shaft, to a vertical shaft rising from the centre of the platform; two or three passages of this wheel, will, it is said, press the brick sufficiently. Followers, raised by treadles, are employed to elevate the brick from the mould. The claim is to "the combination of the circle of moulds, and their appendages, with the wheel, for pressing the clay into the moulds, as above described."

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57. For an inclined *Excavating Box Wheel, for excavating Earth*; James Rowe, Triana, Madison county, Alabama, February 15.

A large wheel, made of iron, is to be mounted on a suitable frame, so as to stand at an angle of about fifty degrees from the perpendicular, [we suppose] the lower edge of this wheel is to rest on the ground, and it has buckets all round its periphery, on its upper surface, which buckets are to receive the earth that is excavated, and to carry it round until it arrives at the full elevation of the wheel, where there is a contrivance for opening the false bottom of the buckets, and allowing the earth to fall through either on to a bank, or into carts, or other vehicles, for its removal; the box wheel revolves on a pivot at its centre, attached to the frame. A wheel of the ordinary kind sustains the other side of the frame of the machine. To the frame is attached a plough, in such a way as that the earth turned up by it shall fall into the buckets of the inclined wheel.

The claims made are, "1st. The above described mode of constructing the revolving box wheel. 2d. The method of opening the shutters of the boxes by the double inclined plane for the discharge of the earth. 3d. The method of adjusting the frame and box wheel, by the crank, arm, and semicircle, together with the combination and arrangement of those parts, substantially in the manner set forth."

The general construction of the apparatus is sufficiently obvious from the drawings and description, but the latter is far from clear in the details. The invention itself, we are very apprehensive, will lend but little aid in the business of excavation.

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58. For an improvement in the construction of *Many chambered Fire Arms*; E. A. Bennett, and F. R. Howland, Waterville, Kennebec county, Maine, February 15.

This many-chambered gun has, we believe, the merit of entire novelty as

regards the manner in which the pieces containing the chambers are combined and arranged. Each chamber is made in a separate rectangular block of metal, of sufficient size for the balls to be used. In the gun which we have seen, there are twelve such blocks; they have hinge joints at their anterior angle, by which they are united so as to form an endless chain of chambered blocks. This chain passes round two cylindrical pieces of metal in the rear of the barrel, by the revolution of which one of the charged chambers is brought into place. The blocks have each a nipple on their upper sides to receive a percussion cap. The claim is to "the construction of an endless chain of chambers, connected together by the hinged joints, arranged and operating substantially in the way herein described."

We have more than once remarked that in the technical vocabulary of patentees, the ordinary meaning of the word improvement is merely alteration, and under this acceptation of the term, the plan before us is a real improvement, although, as we believe, its complexity will render it much less useful than some of its predecessors on the patent list.

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59. For an improvement in the *Plough;* William T. Sprouse, Sangamon, county of Sangamon, Illinois, February, 15.

The improvement claimed is to "the making of the mould and bar out of one single piece of iron, by cutting and bending, instead of making them out of two pieces of iron, and welding them together." The dimensions of the plate and the manner of cutting and bending it, are pointed out in the specification.

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60. For an improvement in the method of making the *Springs for Locomotive Engines, Rail-road Cars, and other Carriages;* Johannes Oberhausser, Charleston, South Carolina, February 15.

The claim under this patent will give a good general idea of what is viewed as constituting the improvements in this spring; it is as follows:

"What I claim as constituting my improvements, is the manner of connecting the leaves of this spring by means of straps passing up between the jogs, or shoulders, and secured by nuts, without the aid of mortises, or notches, and corresponding projections as usually employed. I claim also the mode of forming the centre bearing of this spring, making it a semi-cylinder, which is received into a corresponding cavity in the head of the slide. I likewise claim the dividing it into two or more portions connected and combined at their ends, as set forth."

The last claim refers to the bending the leaves of the springs, towards each end, in such a manner as to leave a space or spaces between them, instead of allowing them to lie upon each other; and afterwards connecting them at their extreme ends by making them clasp round a pin, or stirrup, in the usual manner.

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61. For an improvement in the method of *Fastening Bedsteads;* William Bell, city of Lexington, Kentucky, February 15.

The side, and head, and foot-rails of the bedstead are notched on their sides to admit a short block of wood which crosses from one rail to another diagonally, near to the posts. A single screw passing through the centre of this block into the inner angle of the post, serves to fasten the two rails to each post. The claim is to "the fastening the rails to the posts by means

of a screw and nut on an inner or wooden pin driven diagonally, or through each post, or by a key and mortise as described."

62. For an improvement in the *Boom Derrick*, for hoisting and laying Stone; James D. Savage, Boston, Massachusetts, February 15.

The mast of this hoisting apparatus has a platform surrounding its lower end, for the workmen to stand upon, and upon this platform is situated a frame with two windlasses, acting independently of each other; the ropes from these windlasses pass round two shieves, in the cap of the mast; one of the ropes passes thence round a shieve, and to a block at the end of the boom, with tackle attached to a Lewis for raising the stone in the ordinary manner. The other rope proceeds directly from the head of the mast to a block attached to the Lewis, and serves to draw the stone in towards the mast. The platform at the bottom of the mast, and the cap at its top, both swivel round, and the stone is therefore completely under command, as it can be raised as required by the usual tackle at the end of the boom, be drawn in to any required extent, by the second tackle, and be readily carried round to any point described. The claim is to "the combination of the whole machinery as above described, for the purpose of hoisting stone or other bodies; and, secondly, the second set of machinery, and rope, or ropes, to act on the stone or other body, and draw it in a direction towards the mast."

63. For an improvement in *Water Wheels;* John W. Moon, Roxbury, Delaware county, New York, February 15.

This wheel differs but little from some of the before patented modifications of the re-action wheels, a very numerous family, each individual of which undertakes to coax the water by which it is actuated to exert a power equal to that which it can exercise on a well-arranged overshot; hitherto, however, they have manifested no disposition to violate the laws of hydrostatics, and we are very sure that the present effort will not be more successful than those of former applicants for special favour. The water wheel now under consideration is fixed on a vertical shaft, has spiral apertures close by its periphery, open on its lower and upper faces, is placed so as to fit on to, or into a box, or reservoir below it, into which water is to be admitted through a penstock leading down into it; this water is to pass in at the lower end of the spiral ducts, and out at the upper, and by its exit to drive the wheel round. The claim is to "the use of a wheel having spiral apertures into which the water is admitted from a reservoir below, and discharged at the upper side of the wheel; the whole constituted, combined, and operating, substantially as set forth."

64. For an improvement in the *Regulator for Steam Boilers;* Seth Graham, Roxbury, Norfolk county, Massachusetts, February 15.

This boiler is intended to accomplish the desirable end of indicating and regulating the height of water within it, and, consequently, of obviating one of the main causes of explosions. The means adopted depend upon the action of the old device, a float, but one differently arranged from any which we recollect to have seen described. The float consists of a long, cylindrical tube of metal, closed at its ends, and extending nearly the whole length of the boiler. Through the centre of the boiler passes an iron shaft, which extends out at the front head, its gudgeon there passing through a

stuffing box, and the other end turning in a bearing on the centre of the back head. The float is to be connected to this shaft, by arms, at its ends, of a length nearly equal to the semi-diameter of the boiler, so that the float as it lies on the surface of the water, shall nearly touch its periphery. On to the projecting end of the shaft, at the front head, there is to be affixed a rod crossing it at right angles, and having movable weights affixed to it which may be made to balance the float. Another bar is fixed to the shaft, at the same place, which is called the index arm, and this, as the shaft turns, is to operate on the feed pump, and to regulate its motions. The mode in which it is to do this is not indicated, but is left to the inventive talent of the constructor. A fire flue passes through the boiler, and the flame is to play among circulating tubes. The claim is to "the water regulator constructed and applied to steam boilers in the manner herein described." We see no reason why this float should not be equally good with others upon which the practical engineer places no reliance; nor do we perceive any ground of preference to be given to it. We believe that it still leaves the subject of ascertaining the height, and regulating the supply, of water, open to improvement.

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65. For an improvement in *Fire Arms;* Henry and Charles Daniel, Chester, Middlesex county, Connecticut, February 15.

In this gun the chambers are formed in a revolving mass of metal operating like the cylinder in Cochran's gun, but made polygonal instead of circular, and having a projecting fillet round the mouth of each chamber, to fit into a corresponding recess on the back end of the barrel. As the chambered piece revolves, provision is, of course, made to allow it to recede and advance sufficiently to adapt it to the barrel; this, and other minor points, we shall not take time to describe. The following is the claim:

"We claim the manner in which we have applied such a chamber by fitting it to a recess in the breech, and confining it there by means of the hinged strap, constructed and operating in the manner described."

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66. For an improvement in making *Locomotive Engines and Car-Wheels;* Henry R. Durham, city of New York, February 15.

(See Specification.)

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67. For improvements in the machine for *Tongueing and grooving Boards,* and for working mouldings, &c.; Samuel Shepherd, and Daniel Baldwin, Nashua, Hillsborough county, N. Hampshire, February 21.

In this machine the tongues, grooves, or mouldings, are to be formed by revolving cutters, but the arrangement of the respective parts of the machine, to which the references in the specification are numerous, we shall not attempt to describe, but merely give the claim.

"What we claim as our invention and desire to secure by letters patent, is the construction of the reverse operating, revolving, planing wheels, i. e. the double mouth so as to insert reverse cutters, for the specific purpose of operating with and against the grain of the wood; believing this to be the best adapted mode in use for the purpose of working the various kinds of wood; also, the particular inclining form of the guide and lip, by which the slab is raised perpendicularly above the revolving planing wheel, and kept by the lip from coming in contact with the movements of the machine; also

the particular mode of weighting down the board, or plank, on the carriage as it passes, as specified."

68. For an improvement in the mode of *Constructing the Flues and other parts of Kitchen Ranges*; Samuel Pierce, city of New York, February 15.

In this kitchen range there is an oven above, and one back of, the fire, similar to ovens in some other ranges. There are compartments for heating, or baking, in the hubs, or jambs, on each side of the range, situated like other such compartments, but differing in the connecting of the two hubs at their rear ends by a flue running immediately back of the fire, and separated from it only by the back lining, through which it consequently receives a high degree of heat. From this latter flue, one extends up into the oven first named, so that there is a free communication of heated air among these respective compartments. Above the fire place there are two escape flues, one for the smoke and gases from the fire, and the other for the steam from the culinary vessels.

Claim.—"What I claim as my invention and wish to secure by letters patent, is the connecting of the compartments in the hubs, by means of the flue running behind the fire. I do not claim the compartments, only as thus combined and connected. I claim also the connecting of these compartments and flue with the oven, in the manner and for the purpose set forth; and I likewise claim the constructing of a flue for steam and vapour, distinct and separate from the smoke flue, upon the principle, and for the purpose, set forth."

69. For a discovery in the *Manufacture of Brown Paper*, from a new material called Sand Grass; Isaac Sanderson, Milton, Norfolk county, Massachusetts, February 22.

(See Specification.)

70. For an improvement in the *Machine for washing Rags*, in the manufacture of Paper; Robert Carter, Elkton, Cecil county, Maryland, February 22.

Claim.—"The improvement claimed consists in the arrangement, as described, of the inclined screen of the washing engine of the paper mill, below the axis of the cylinder, instead of above it, so as to separate the foul water from the pulp, by causing the water to descend by its gravity through the inclined screen and pass off through apertures in the side of the cistern into a box constructed on the outside thereof, regulated by a gate, whilst the rags and pulp pass gently down over the screen into the cistern again, and around the partition to the cylinder, to be acted on in like manner, instead of the old method of placing the screen above the axis of the cylinder, and dashing the foul water through it by the motion of the cylinder, which necessarily drives with it a large portion of the pulp, thus causing a great waste of material to the manufacturer."

71. For an improvement in the *Artificial Horizon*, for Quadrants and Sextants; Charles Goulding, city of Mobile, Alabama, February 24.

A glass tube bent in the form of the letter U, is to contain a coloured liquid. The ends of the tube are to be capped with brass, a tube passing from one cap to the other, to allow a free communication of air. This

apparatus is to be attached to the quadrant, or sextant, in such a manner as that the two ends of the column of liquid shall be in the same plane with the sight, which will be in the centre of the chord of the curve formed by the column of liquid. The claim made is to "the arrangement of the water level with the quadrant or sextant in the manner described, for showing the place of the horizon when it cannot be seen; which will enable navigators to take a correct observation of the sun's altitude, when the sun is clear in the heavens, and the horizon is covered with a thick vapour, and invisible."

We are of opinion that a correct observation cannot be obtained by the means proposed; the capillary attraction alone, we apprehend, would prevent this, even in a vessel considerably larger than any tube that can be employed, attached to the quadrant. The surface of the fluid would never be flat, and its adhesion would render its motion sluggish.

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72. For an improvement in *Operating the Treadles in Power Looms;* Eli Norton, Stafford, Tolland county, Connecticut, February 22.

The claim is to "the arrangement of a single set of wheels with eccentric grooves for vibrating the levers, or treadles, for raising and drawing down the harness of the looms, as described."

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73. For an improved *Spark-arresting Flue for Locomotives;* Johannes Oberhausser, Charleston, South Carolina, February 24.

There are to be two, or more, enlargements of the ordinary flue, constituting drums of about three times its diameter; below each of these drums wire gauze is to be stretched across the flue, and near the bottom of each drum there is to be a partition perforated with three, four, or more, large holes; into which tubes are fitted which rise nearly to the tops of the drums, and are there recurved, so as to cause the sparks to descend and fall on the partitions which sustain the tubes.

The claim is to "the combination of the various parts as described; that is to say, the constructing of two or more drums or chambers, of greater capacity than the flues, with their partitions, recurved flues, and sheets of wire gauze, all constructed, arranged, and combined, as set forth." Which arrangement, construction, and combination, if they serve to arrest the sparks, will, at the same time, serve to arrest the draught also.

Specifications of American Patents.

Specification of a patent for an improvement in the manufacture of Brown Paper, from a new material called Sand Grass. Granted to Isaac Sanderson, *Milton, Norfolk county, Massachusetts, February* 22, 1838.

To all to whom these presents shall come, I, the undersigned, Isaac Sanderson, of Milton, in the county of Norfolk, and commonwealth of Massachusetts, paper-maker, send greeting.

Be it known, that I, the said Sanderson, have discovered and invented a new and useful improvement in the manufacture of Brown Paper, by the use of a new material for that purpose, not in use before, of which the following is intended to be a full and exact description; that is to say, I use

for this purpose a grass which usually grows in the sand upon beaches near the sea-shore, and above the usual high-water mark, commonly called sand grass, or beach grass.

This grass is to be cut down and dried in the usual way. A convenient quantity is then to be taken and put into a vessel, or cistern, and boiled in a solution of lime, or potash, over a fire, or by steam, for about two hours. The solution is to be made by putting about the proportion of a peck and a half of lime, or three pounds of potash, to a hogshead of water. After the grass has been thus boiled, it is to be taken from the vessel, or cistern, and cut into pieces two or three inches in length, in the way and manner in which materials are usually cut for making paper. When so boiled and cut, it is to be put into the engine and beaten; and while the process of beating it is going on, potash dissolved in water, in the proportion of six lbs. of potash to two hundred pounds of this grass, and train oil, or spermaceti oil, in the proportion of about half a pint to the same quantity of the grass is to be put into the engine, so as to mix with the material and the water in the engine. The grass is there to be beaten and prepared in the usual way of preparing materials for making paper.

What I claim as my invention and discovery, is the use of said grass, in, and for, making brown paper. ISAAC SANDERSON.

Specification of a patent for a composition of matter for the cure of Salt Rheum, and other purposes. Granted to WILLIAM B. TRUFANT, *Bath, Lincoln county, Maine, February* 10*th*, 1838.

Be it known that I, William B. Trufant, of Bath, in the county of Lincoln, and state of Maine, have invented a new composition of matter as a remedy for the Salt Rheum, and other humours of a similar character, consisting of a mixture to be taken internally, and of an ointment to be applied externally, at the same time, of which a full and exact description of the composition, mode of preparing and using, is as follows, viz:

The mixture for inward application is composed of the inner bark of the black cherry, yellow birch, white ash and white poplar, or aspen, trees—and of the black alder and coffee hazel shrubs, or bushes, all ground about as fine as coarsely ground coffee, so as to be convenient for steeping, to be used when dried sufficiently for grinding. Also the leaves and stock of the lignum pinæ plant, dried and pulverized about as fine as the barks, and the wood of the lignum vitæ tree, scraped, or rasped, as fine as common saw-dust; and common blue clay. These may be used in equal quantities, but I prefer less, say one half as much, of each of the last four named articles, as of each of the others. When mixed together, it must be steeped in water, at the rate of one ounce of the mixture to two-thirds of a pint of water; the steeping to be performed by pouring on the water, in a boiling state, and after keeping it on, at nearly boiling heat, for about ten minutes, pouring it off to cool for the use of the liquor. I do not, however, prepare the liquor for sale, inasmuch as it will sour in warm weather, generally in a week; and therefore no more should be steeped in summer than may be used in four or five days, as it is worthless when sour. I intend to offer the mixture for sale, ready for steeping, with directions. The liquor thus to be prepared, is to be taken night and morning until a cure is effected; which will, ordinarily, be from one to three months, according to the nature of the case.

An adult patient may commence with about a wine-glass full for a dose, increasing to double that quantity in two or three days. It should be taken before breakfast, and shortly before going to bed, while the stomach has not much food in it. Children should take in proportion to age and strength, although some excess would not be dangerous; and if the patient be a nursing child, it is better that the person affording the nourishment should take a half dose, while the child may take less in proportion. The liquor may be sweetened with molasses, if preferred by the patient.

The ointment consists of fresh butter, (for which lard may be substituted, if butter cannot conveniently be had) tar, rosin, spirits of turpentine, red precipitate, and a sirop made of about the consistency of thin molasses, from the bruised, or ground root of the lignum pinæ plant; in the proportion of half a pound of butter, half an ounce of the precipitate, two ounces of tar, two ounces of rosin, one gill of spirits of turpentine, and a table spoonful of the sirop. These should be immersed together until, when cool, they form an ointment of about the consistency of butter.

This ointment is to be used by rubbing it with the hand on the parts affected, until the pores of the skin are well filled with it, at night only, after taking the liquid of the mixture inwardly, beginning its use only after having taken the other five or six times, and continuing it until a cure is effected.

When the lignum pinæ plant cannot be obtained, the mixture and ointment are useful without it, although less efficacious.

What I claim as my invention, and desire to secure by letters patent, is the composition of matter, consisting of the mixture, and ointment, containing the several articles aforesaid, to be used as before described, as a remedy for the Salt Rheum, and other similar humours, or complaints.

WILLIAM B. TRUFANT.

Specification of a patent for an improved process of Bating Hides and Skins. Granted to WILLIAM ZOLLICKOFFER, *Middleburg, Carroll county, Maryland, February* 3, 1838.

To all whom it may concern, be it known that I, William Zollickoffer, of Middleburg, in the county of Carroll, and state of Maryland, have invented a new and useful improvement for bating all kinds of Hides and Skins, and I do hereby declare that the following is a full and exact description.

The nature of my invention consists in using the muriate of ammonia as a bate for all kinds of Hides, or Skins, either alone, or in combination with either hens' dung, pigeons' dung, or dogs' dung, with which I bate them in a much shorter time than is required by using either of the three last mentioned substances alone.

To enable others skilled in the art to make and use my invention, I will proceed to describe the manner of using it, and its operation. When I use the muriate of ammonia alone, I take seven pounds, which I reduce to a coarse powder, and upon which I pour ten gallons of hot water, in order to facilitate its solution. This solution I throw into a vat containing a sufficient quantity of clean water to cover five hundred pounds of Hides, or Skins, dry weight, in a state of preparation for the bate. Into the bate I thus prepare, I throw in this quantity of Hides, or Skins; with which I bate all kinds of skins in one hour; horse hides in two hours; and ox hides, and other thick hides in three hours. The ox hides, and all other hides, I han-

dle once during their continuance in the bate; in an hour after they have been placed into it; and when I use the muriate of ammonia in combination with either hens' dung, pigeons' dung, or dogs' dung, I take two pounds and a half of the muriate of ammonia, which I dissolve in four gallons of hot water, after having previously reduced it to a coarse powder. This solution I throw into a vat containing the necessary quantity of either hens' dung, pigeons' dung, or dogs' dung bate, that is required for bating five hundred pounds of hides, or skins, dry weight. Into the bate I thus prepare, I throw this quantity of hides, or skins, in the usual state of preparation for undergoing the process; taking care, however, previously to place them into a pool of clean water for five minutes, to wash off the dirt and ime. With this process I bate all kinds of skins in three hours, horse nides in six hours, and ox hides, and other thick hides, in nine hours. The ox hides, and other thick hides I handle three times; the end of the second, fourth, and sixth hour after they have been submitted to its operation. Horse hides I handle twice; the end of the second and fourth hours; and all kinds of skins I handle once, the end of the first hour after. The hides and skins which are bated with this process are reduced and softened, and in every way prepared for the bark, analogous to those which are bated with either hens' dung, pigeons' dung, or dogs' dung alone; and the hair, dirt, and lime work out with equal ease. After they are bated with my process, they are to be stoned, or treated over the beam, like all other hides and skins.

What I do claim as my invention, and desire to secure by letters patent, is the application of the muriate of ammonia as a bate for all kinds of hides and skins, either alone, or in combination with either hens' dung, pigeons' dung, or dogs' dung, as herein described, using for that purpose any substances which will produce the intended effect.

WILLIAM ZOLLICKOFFER.

Specification of a patent for an improvement in making Wheels for Locomotive Engines and Rail Road Cars. Granted to HENRY R. DUNHAM, *city of New York, February* 15, 1838.

To all whom it may concern, be it known, that I, the undersigned, Henry R. Dunham, of the city, county, and state of New York, Engineer and Machinist, have invented a new and useful method, or improvement, in making *Locomotive Engine and Rail Road Car wheels*, and I do hereby declare that the following is a full and exact description thereof.

This wheel I cast in an iron mould and is properly called the *Chilled Wheel*, from the fact of being hardened on the entire periphery, caused by coming in contact with the iron mould at the time of casting it; but instead of continuing the arms of the wheel to the rim, as is now the case, and partly annealing that section of the rim to which it extends, I make two rims, the space between them being two inches, the same can be more or less and continue the arms of the wheel no farther than the inner rim, thereby leaving an uninterrupted space under the outer rim of two inches, more or less; which gives to the outer, or chilled, rim, an even tempered, or chilled, surface, (more durable and not liable to flatten opposite the arms, obviating that difficulty in the wheels now in use) the outer rim being connected by the sides, or edges, to the inner rim, to which the arms of the wheel extend. The space between the inside and outside rim is made by

the insertion of cores, supported at intervals by cores, in the usual manner. What I claim as my invention, or improvement, and desire to secure by letters patent, is the making of two rims, connected at the sides, and leaving an uninterrupted space under the outside rim, excepting where it is joined at the edges, or sides of the wheel, and the said vacant, uninterrupted space extending entirely around the circumference of the wheel, between the outer and inner rim; in other words, constituting a hollow felly, cast in one hollow, connected mass, entirely around said wheel; and the whole wheel, it may be further remarked, is cast in an entire casting.

HENRY R. DUNHAM.

English Patents.

Specification of the Patent granted to RICHARD TAPPIN CLARIDGE, *of the County of Middlesex, for a Mastic Cement, or Composition applicable to Paving and Road making, covering Buildings and various purposes to which Cement, Mastic, Lead, Zinc, or Composition are employed.*—Sealed November 25, 1837.

To all to whom these presents shall come, &c.—*Now know ye*, that in compliance with the said proviso, I, the said Richard Tappin Claridge, do hereby declare the nature of the said invention, to consist in a combination by means of heat, of certain substances hereinafter described into a mastic cement or composition applicable to paving and road making, and various purposes to which cement, mastic, lead, zinc, or composition is employed, and one of such substances is a natural compound, consisting principally of carbonate of lime and bitumen, with a small portion of aqueous and other matter, and such natural compound is commonly called or known by the name of asphalte or asphaltos or calcareous asphalte, asphaltic mineral, or asphaltic rock, or asphaltic stone, and such natural compound is hereinafter called asphalte, it is found at Pyrimont, near to Seyssel, in the department De l' Ain, in the kingdom of France, and in other parts of the Jura Mountains, and in other places in great abundance; and the other of such substances is bitumen or mineral or other pitch; and I do hereby describe the manner in which the said invention is to be performed by the following statement. I take the said asphalte in its native state, as it is extracted in masses from the mine, and I greatly prefer, for the purpose of my invention, the asphalte from Pyrimont, aforesaid. The said asphalte from Pyrimont aforesaid, contains, in addition to a small portion of aqueous and other matter, carbonate of lime and bitumen in about the proportion of ninety parts of carbonate of lime to about ten parts of bitumen, and the cement formed accordingly to the said invention, from the said asphalte of Pyrimont, and bitumen, is better than that formed from any other asphalte which I have yet been able to procure, although asphalte is found in other places. And I reduce the asphalte to powder. The asphalte may be reduced to powder solely by mechanical means, but the reduction thereof to powder is facilitated by heat. I usually place the masses of native asphalte in a furnace or oven, the bottom whereof is made of plate-iron; in about half an hour, by the application of a brisk fire, the asphalte falls or is readily

reduced to powder, the asphalte after being exposed to heat, as above mentioned, or otherwise, or reduced to powder, or small parts, by mechanical means, is then passed through a sieve, the meshes of which are about one fourth of an inch square; the asphalte which has passed through such sieve is in a fit state to be mixed with the bitumen or mineral or other pitch; the bitumen or mineral pitch is found in a natural state combined with earthy or other matter in great quantities in the neighbourhood of Pyrimont, and in other places. I have ordinarily used the bitumen found in the neighbourhood of Pyrimont, but the bitumen as found elsewhere may be used without injuring the quality of the cement produced, or other pitch may be used instead of such mineral pitch aforesaid; the bitumen is freed from its extraneous matter in the ordinary way.

In forming the cement or composition according to the said invention, when I use the asphalte of Pyrimont, and the bitumen or mineral pitch also from the neighbourhood of Pyrimont, I take about ninety-three parts of asphalte reduced to powder, and passed through such sieve as aforesaid, to about from seven to ten parts of such bitumen or mineral pitch. The quantity of bitumen intended to be used is first placed in a melting cauldron or furnace, and when it is dissolved the powdered asphalte is added gradually, the mixture is kept carefully stirred in order that it may not be burnt, and also that the asphalte and bitumen may be perfectly amalgamated, the mixture is kept over the fire, carefully stirred, until the whole is thoroughly combined and is nearly fluid. This combination is the mastic cement or composition according to the said invention. The melting cauldron or furnace should be kept over rather a slow fire until the mixture is nearly in a state of ebullition, it then gives out a light white smoke in jets, and it is fit for use. When other asphalte is used, instead of the asphalte of Pyrimont, the quantity of bitumen to be added, will vary according to the particular nature of the asphalte, and the proper quantity will easily be found by trial, and when bitumen or mineral, or other pitch, than that from the neighbourhood of Pyrimont is used, the precise proportion will easily be determined by trial. In applying the said cement or composition to paving, I add to about every 200 pounds weight of the nearly fluid mastic cement, about half a bucket full of very small, clean, and hot gravel or sand; this is carefully stirred up with the mastic, and as soon as it is sufficiently fluid, that is as soon as the mastic begins to give out the light white smoke previously described, it is fit for use. It may then be run into moulds, and remain until cold, when it will form blocks or slabs, which may be laid upon any proper foundation, one consisting of concrete and mortar, is usually adopted. These blocks or slabs are cemented together, by pouring the fluid mastic cement either mixed as aforesaid, with fine gravel or sand or without fine gravel or sand, between the interstices of the blocks or slabs, sometimes a thin coating of mastic cement is spread over the foundation, and the blocks or slabs are imbedded therein, in such case the cement is also poured in between the interstices, as above described. If it be desired that the pavement should be ornamented so as to represent mosaic or other work, the process of forming the blocks or slabs is as follows:—

First, a large flat surface is formed, either of wood or plaster, upon which the required pattern is drawn: this surface, or a convenient portion thereof, is enclosed with iron bars of the intended thickness of the slab;

over this surface, a thin coat of transparent glutinous size, is spread; as the following work advances, pebbles of various colours, pieces of porcelain-ware, earthen-ware, glass, or other materials, of the required forms and colours, are deposited upon their allotted portions of the patterns, either to represent foliage or fret-work, or any other device; by means of the weak size, they are very lightly retained in their places, the mastic cement or composition heated as above, and either mixed with fine gravel or sand, as aforesaid, or unmixed, is poured into the space enclosed with iron bars as aforesaid. This mastic cement or composition, fills up the interstices between the pebbles, pieces of porcelain-ware, earthen-ware, glass, and other materials, and forms with them a hard slab—this is inverted, and slabs thus formed, are cemented together in the same manner as blocks or slabs are previously described to be cemented. In forming ways or paths I usually proceed thus. Upon a proper foundation, I place two flat iron bars parallel to each other at a convenient distance from each other, say, from three to four feet—these bars are of the thickness to which the the mastic cement or composition is intended to be spread, usually about half an inch thick; between these bars, the fluid mastic and fine gravel or sand, mixed as aforesaid, is poured and spread, and the surface made regular and uniform, by passing a thick piece of wood, with one straight edge, backwards and forwards upon the iron bars. Upon this surface, whilst still in a semi-fluid state, I usually sift fine hot gravel, which I beat into the mastic with wooden stampers. When the mastic is set, the operation is repeated until the surface required for the way or path is covered. As the operation proceeds, the surface of the cement already set, renders the use of the iron bars unnecessary.

I apply the said cement in road-making, either superficially in manner hereafter-mentioned, that is to say, upon the surface of a road formed of the usual materials, in the usual way, and the bottom whereof has undergone the usual preparations, I pour the said mastic cement or composition, either with or without fine gravel or sand, when the same is heated just so as to give out the light white smoke, as aforesaid, and the said mastic cement or composition, forms with such stones, a hard and compact surface; or I apply the said mastic cement under the hard materials, and in such case I spread a thin coating of the said cement, either mixed with or without fine gravel, or sand, between the substratum and the hard materials, for the purpose of preventing the hard materials being injured by the land-springs.

In applying the said cement or composition for the purpose of covering buildings, I usually cover the roof with canvas, similar to that used by the paper-hangers, stretched tolerably tightly, and upon this canvas I spread a layer of the said mastic cement, heated as last aforesaid, to about the thickness of four-tenths of an inch, and upon the surface of the said mastic, and when the same is in a semi-fluid state, I sift gravel previously heated in a caldron; and, as the mastic sets, I beat the said gravel into the said surface of the said mastic, with flat wooden stampers, about fifteen inches long and nine inches broad, until the gravel is incorporated into the substance of the said mastic.

The process of applying the said mastic to the lining of tanks, reservoirs, and various purposes to which cement, mastic, lead, zinc, or composition is employed, is very similar to that previously described. In such linings, no gravel or sand is used with the said mastic, but a coating thereof is applied whilst the mastic is of the heat hereinbefore-men-

tioned (that is to say), when it just begins to give out a white light smoke, previously described; for the bottom surface of tanks or reservoirs, a simple covering of the said mastic, applied in a manner aforesaid, is sufficient; for the sides of such tanks or reservoirs, the face of each brick, which is intended to be inwards, and exposed to the water, is first covered with a thin coat of the said mastic cement or composition; this is done by laying the bricks side by side, on a level of ground, as if they were to form a pavement, then the fluid mastic is thinly spread over their whole surface; as soon as it begins to set, which is in a few seconds, and before it becomes hard, the blade of a large knife is passed between the bricks, cutting the mastic through, at the same time the process leaves each brick with one face covered with the said mastic cement. This done, the walls or sides of the tanks or reservoirs, are built, and each brick is set in fluid mastic, instead of calcareous mortar or cement, and for greater security, a space of about half an inch is left between the inner and outer bricks, which form the side-walls of tanks or reservoirs: this space is filled up with the fluid mastic, as the brickwork advances; this is the process usually adopted. From the above descriptions of the application of the said mastic cement or composition, it may easily be applied to various other purposes, to which cement, mastic, lead, zinc, or composition, is employed. And whereas, I do not claim as the said invention, the mode of reducing the said asphalte to powder, or the separate use of the said asphalte, or bitumen, or mineral, or other pitch, as a mastic cement or composition; but I do claim, as the said invention, the combination, by means of heat, of asphalte, meaning thereby a natural compound, consisting principally of carbonate of lime and bitumen, with a small portion of aqueous and other matter, by whatever name or names such natural compound be called or known, and bitumen, or mineral, or other pitch, into a mastic cement or composition, applicable to paving and road-making, and various purposes to which cement, mastic, lead, zinc, or composition is employed. And such invention, being to the best of my knowledge and belief entirely new, and never before used within that part of Her said Majesty's United Kingdom of Great Britain and Ireland, called England, Her said dominion of Wales, or town of Berwick-upon-Tweed; I do hereby declare this to be my specification of the same, and that I do verily believe that this my said specification doth comply in all respects, fully, and without reserve or disguise, with the proviso in the said hereinbefore in part recited letters patent contained, wherefore I hereby claim to maintain exclusive right and privilege to the said invention.—In witness whereof, &c.—[*Enrolled May* 25, 1838.]

Rep. Pat. Inv.

The Asphalte Mastic is obtained from Pyrimont, near Seyssel, and brought down the Rhone, and is a compound of a carbonate of lime and mineral pitch. After being roasted on an iron plate it falls to powder, or may be readily pounded. By roasting it loses about one-fortieth of its weight. It is composed of nearly pure carbonate of lime, with about nine or ten per cent. of bitumen.

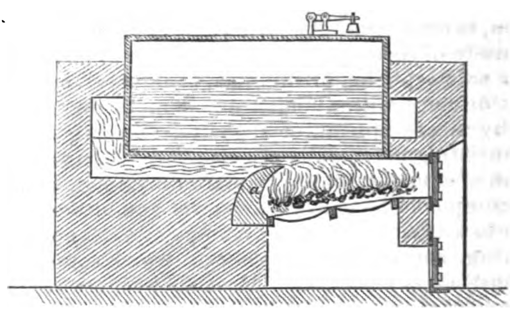
When in a state of powder it is mixed with about seven per cent. of a bitumen or mineral pitch, found near the same spot. This bitumen appears to give ductility to the mastic. The addition of only one per cent. of sulphur makes it exceedingly brittle. The powdered Asphalte is added to the bitumen when in a melting state; also a quantity of clean gravel, to give it a proper consistency for pouring it into moulds. When laid down for pavement, small stones are sifted on, and this sifting is not

observed to wear off. The mass is partially elastic, and Mr. Simms had seen a case in which a wall having fallen away, the Asphalte stretched, and did not crack. It may be considered as a species of mineral leather. The sun and rain do not appear to have any effect upon it; it answers exceedingly well for the floors of the abattoirs of the barracks, and keeps the vermin down; and is uninjured by the kicking of the horses feet. It may be laid down at from eightpence to ninepence per square foot.

Journ. Arts and Sci

Specification of a Patent granted to John Hopkins, *of the county of Middlesex, surveyor, for his invention of improvement in furnaces for steam-engine boilers and other purposes.*—[Sealed 18th June, 1836.]

This invention consists merely of an improved fire bridge of a curved form, constructed in such a manner that the heat and the flames are arrested in their progress and thrown back from the end of the furnace, and in some measure caused to pass again over the surface of the burning fuel; by this means, the vapours arising from the combustion of that part of the fuel which is onlv partly ignited will be consumed.



The figure represents a longitudinal section taken through a furnace and steam-engine boiler, showing the position of the improved fire bridge, which is represented at *a*, and is constructed of fire brick; it will be seen that the fire bridge, instead of merely intercepting the flames, as in the ordinary construction, and causing the heat to rise upwards and act on the under surface of the boiler, by its bent form, causes the flames and heat to be driven back, and to act more effectually all along the under surface of the boiler.

The Patentee further states, that in marine and some other constructions of boilers, the fire bridge may be constructed of metal, and hollow, for the water of the boiler to pass into and become heated, instead of making it of fire brick.

It will be evident, from the foregoing description, that although the invention has been described as adapted to furnaces of steam-engine boilers only, yet it is equally applicable to the furnaces of other boilers in which bridges of the ordinary construction are used. In conclusion, the Patentee says, "Having now described the nature of my invention, and the manner of carrying the same into effect, I would have it understood that I claim, as my invention, the construction of the fire bridges of the furnaces of steam-engine and other boilers, as above described, either of fire brick, metal, or other suitable materials.—[*Inrolled December*, 1838.]

An account of a recently invented Patent Spring, called "The Safety Spring," and applicable to Carriages and Carts of every description. By the* Rev. R. J. Barlow.

When springs were first brought into practice, they were imagined to be useful merely to give ease to the traveler, and a certain degree of security to fragile articles; reflecting persons, however, quickly discovered them to be a great means of saving the carriage and lessening the draught, which latter is clearly proved in the works of Drs. Helsham and Arnott. To save the road upon which we travel, has, since the formation of railways, become a consideration of the utmost importance, and so perfectly convinced are scientific men of the value of springs for that purpose, that the eminent engineer, Mr. Stephenson, does not permit a single wagon to be run upon the Manchester and other lines under his direction without springs, although the weight and expense thereby added to each wagon is very considerable.

Hence, it is evident, that besides the comfort and convenience of springs, their chief advantages consist in saving the horse or engine, the carriage itself, and the road upon which it travels; and consequently, the only argument against their being universally adopted by the Ordnance Department, and for farming carts, and common stage wagons, must arise from their being so expensive, so liable to break, and so ponderous when employed for heavy wagons, all which evils are in a great measure obviated by this invention, the peculiar properties of which may be thus briefly enumerated.

A greater degree of ease than those now in use;—almost perfect security against breaking, under any circumstances;—a saving of weight upon railways to the amount of three-fourths, upon the common roads to the extent of two-thirds;—much cheaper;—a direct up and down motion, which prevents the swinging and rolling of the carriage, and consequently secures it against being overturned under any extent of load;—simple, capable of being repaired by the most indifferent mechanic,—may, upon emergency, be increased in strength for bad roads and heavy luggage;—preserves the graceful appearance of the C spring so completely as to deceive the eye, and in all other cases is lighter and more elegant than those now in use.

That this spring is easier than those in general practice has been proved by comparing them with some of the best London manufacture for the space of a year, during which they were tried upon the worst description of roads: again upon the Whitby railway, where they have been in use for some months, they are found to have a much more pleasant motion than any hitherto employed. This is attributable solely to the spring being acted upon instantaneously, and completely without friction, which prevails to an enormous degree in the old springs, and renders them stiff or wooden to a great extent.

The superior security of this spring may be proved in this manner. The levers are constructed of two pieces of one-fourth inch plate iron, distant from each other, two or three inches, and connected by one or more small blocks of wood, or, as in the case of the C spring, by one solid piece, all firmly riveted together; by this means the iron receives the strain edgeways, and, like the blade of a saw, or knife, supported in such a position, it may, with little weight, be made equal to any load.

The spring itself never exceeds eight or ten inches in length, and con-

* Communicated to the Whitby Philosophical Society by the Rev. R. J. Barlow, the patentee, of Linden Grove, near Stokesby, Yorkshire, September, 1836.

sists of several steel plates of a lozenge shape, inserted in a kind of case called a stop (from its regulating the quantity of motion and stopping it at a certain given limit.) This stop, by its tongue running through the centre, divides the plates into upper and under series, and contains, at each end, a rack or rest for every plate, which being supported at the extremities, the whole spring is pressed in the centre directly like an elliptic spring, and since every plate is supposed to be capable of bending more than it is permitted, it is not possible that the spring can ever break, because it is checked before it reaches the breaking point. Let it not, however, be imagined, that being thus checked, the motion must be unpleasant, for if the spring be proportioned to the weight, it will never collapse but with such a shock as might endanger the carriage. It should also be mentioned, that whereas all springs are found to break, or set, and lose their shape and original position if too heavily laden, this safety spring will, on the contrary, always return to the same height, when the load is taken off, be it ever so great; for, as has been shewn, it is impossible to break the spring, and when it has gone home, the strain then becomes entirely upon the levers, which are made beyond any, even the utmost calculated weight or strain.

The difference of weight between these springs and the old ones, has been accurately determined at the Whitby Railway, and is as follows:—old springs for a 3 tons carriage, 372 lb.; new springs for a 3 tons carriage, 90 lb., being, as stated above, a saving of three-fourths in weight; but it is further to be remarked, that in the old springs, double the load requires double the weight of springs; whereas in this invention, the spring alone requires increase, directly as the weight, a few pounds additional to the levers being sufficient; thus, for instance, on the Whitby line, 3 tons take springs of 90 lb., but 156 lb., is sufficient for 6 tons, the levers being increased by only 6 lb.

The saving of expense is evident from the simple nature of the invention, because all the parts can, without loss of steel, or iron, be cut in the cold state by heavy machinery, after which little hand labour is necessary: again it is to be considered that there is never more than one-third of the material employed, and that one-half of that is iron instead of steel.

The direct up and down motion will thus appear. In all cases, such as public coaches, phaetons with perches, and gigs, where the springs can be conveniently placed so as to run, not across, but along, the axle, should the weight by a jerk be thrown to one side, the lever or levers on that side will work the springs, and those on the opposite side being freed from duty, will fall at the same time, by which means the carriage is compelled to descend at both sides alike, and therefore will move directly up and down only, so far as the springs are concerned; whereas with the present springs, when the weight is thrown to one side, the opposite side of the spring being relieved from pressure, kicks up, and tends much to make the carriage swing and overturn.

The facility of increasing the strength for bad roads or heavy luggage, will be understood by supposing the stop and the racks to be so arranged, as to be capable of receiving at the top and bottom one or more plates. This will materially increase the strength, and may be performed by an ordinary servant. In the levers no change is requisite, as they are always capable of working a spring of much greater power than would suit the carriage under ordinary circumstances.

Fig. 1.

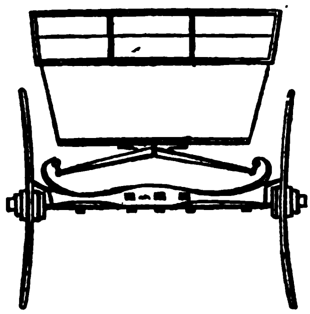


Fig. 1, exhibits the back of a phaeton hung so as to have the up and down motion, and avoid the side swing.

Fig. 2, represents the frame of a railway carriage, as seen with the patent springs and double guide plates of one-fourth inch plate iron, made, as shewn, of several pieces riveted together, or cut out of a single sheet. It is to be noticed, that the spring box plays within the guide plate, and thus the dirt and dust are kept from the oil, or the piece riveted on may be cut off, so as to allow the spring box to play outside, if preferred.

Fig. 2.

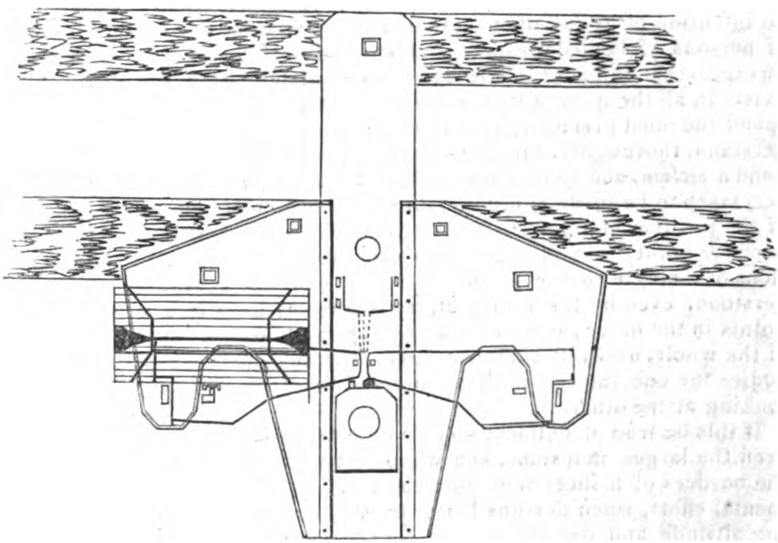


Fig. 3.

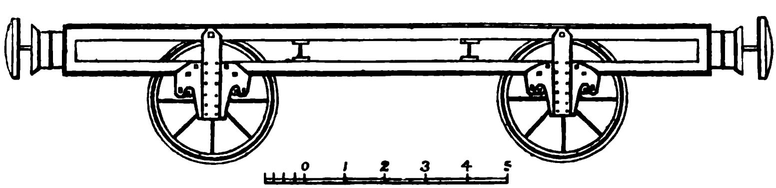


Fig. 3. exhibits, on a larger scale, the same kind of guide plate, which is expressed as if transparent, to render the inner works visible. Thus the shape of the spring box, the *position* of the syphon, the shape and action of the levers are apparent; and there is also displayed on one side a single spring of a 6 ton wagon inserted in its stop or case, the dark line being the tongue and rest.

In the plan above drawn, the carriages and wagons are hung lower than usual.

It may be necessary to add, that the small quantity of motion in the spring (not exceeding half an inch) is multiplied many times by the lever, before it is communicated to the carriage. Ed. N. Philos. Journ.

Progress of Civil Engineering.

Sectio-Planography.

We insert the following paper from the British Magazine of Popular Science, as well for the value of the mode of delineation it describes, as for the raciness of the style in which it is written. G.

We believe we may say without fear of contradiction, and certainly with no intention of giving offence, that, comparatively, a very small number of persons of landed property understand a *plan*. This is principally owing to that culpable deficiency in practical education, which at present exists in all the great establishments in which our more elevated ranks spend the most precious years of their lives. If but a small number understand, thoroughly, a plan, still smaller is the number who can comprehend a *section*, and that combination of both *plan and section*, which is necessary to be made and understood before a clear idea can be obtained of the position of a particular part or point, with regard to all the other parts or points that surround it in every direction. The plans and sections of a single edifice are not to be thoroughly and satisfactorily understood, even by the architect, at a glance; lines in one, shrink into points in the other; planes become lines; and he cannot prudently judge of the whole, until, by sufficient study, his imagination so distinctly embodies the one, that he can instantly and involuntarily combine it, when looking at the other.

If this be true of delineations of objects so limited in magnitude as even the largest mansions, and whose delineated areas rarely extend to the borders of a sheet of double-elephant, how far greater must be the mental effort, when designs run from sea to sea, over a country of varying altitude and depression, and whose delineations even when miles are compressed into inches, defy the continuous longitude of an "endless sheet." Persons who have never visited that Office of the House of Commons where the plans and sections of intended rail-roads are annually deposited, can have no idea of the scene. One would think that the whole country had been stripped of its epidermis, that it had been manufactured into striated paper, and deposited there.

When a *line* is to be examined in a committee of the House of Commons, it is soon found that it is not a mathematical one in any sense of the word. The *breadth* of the line, and its horizontal vagaries, generally require the broadest kind of paper, and sheet after sheet, or rather ream after ream, until the scale of length prescribed by the "Standing Order" is accomplished. The *depth* of the line, and its vertical undulations, are far more reasonable in their demand for breadth, yet they have the same insatiable appetite for length. When the plans and sections necessary for the inquiry intended first appear before a committee, they have no

very alarming appearance;—a portfolio, of no very gigantic dimensions considering the occasion, generally labelled "PLAN," in gold upon red, and a cylinder, perhaps a foot high, and of a diameter varying from two inches to eight, embodies the SECTION; but when under the process of examination, cross-examination, re-examination, and questions by committee, the engineer to the undertaking and his assistants, and the opposing engineers and their assistants, have turned over and turned back, unrolled and rolled, and unrolled again, portfolio and cylinder, with the most contrary intentions of comparing and combining, and proving and disproving, and have covered tables and floor with their convolutions, some little idea may be formed of the quantum of accurate informtion, which an impartial and constantly-attending member of a committee may obtain after fifty days' inquiry, particularly if he happen to be a "gentleman born."

But, as every country gentleman is not a member of a parliamentary committee, it may be hastily presumed that these perplexing mysteries can never annoy him. With the country, scored as it is with intended railways, no such gentleman can escape. This very portfolio and cylinder, or some few yards of each, is certain to roll into his hall, and be deposited on his library-table, either by friend or enemy, and he will find, sooner or later, that, though in undisputed succession of an ancestral estate, rich in preserves where poacher never entered, though a lover of that nature which has spread some of her loveliest scenes within his domain, and possessing health, and a keen relish for the field, this mysterious pair of unlike forms are the certain precursors of mighty evil. After a little time of execration on the COMPANY and their agents, he sits down with his attorney and surveyor. The three together can decide, within a mile, how near the railroad will approach that wood, or this lawn, and, perhaps, the amount of the lop-sided angle it will fill up of that sheet of water, which cost his grandfather thousands to create, in the geometrical style of gardening of his day. But the question, how the railroad is to maintain its level, and run down the side of that valley, and over that ridge, strikes out numerous inquiries, which end in the unrolling of the cylinder, and, in fact, nothing more; for after hours spent in attempts to combine the Section with the Plan; to connect the horizontal conditions of the one with the vertical conditions of the other, divorced as they are, the consultation generally ends, with, perhaps, a point or two accurately ascertained, but assuredly with a vexatious conviction, that some great mischief is about to be perpetrated, but in what way, or to what extent no clear notion has been obtained. What is the consequence? The landed proprietor either opposes the bill, shutting his ears against every proposition which might mitigate or remove the evil, and putting himself and the promoters to immense expense; or, as the final event is, nine times out of ten, the same, he saves great pain, cost, and vexation, by doggedly submitting to his executioners. His estate is then dismembered, and his enjoyments destroyed, in a legal manner, under the humane superintendence of the acting engineer of the company. In two or three years, if the calls are paid up, instead of the green, sheltered, turfed and meandering lanes, there will be the sterile, exposed, iron road, having the very picturesque qualification of "no curve of less radius than a mile." There, where the owner used to meet the lamb and its mother, and hear the tinkling bell of some fellow-wanderer he may be crushed by a locomotive; for though he hears its snorting a

mile off, he has but a second or two to climb the "cutting of one to one," to save his life. Game he may find at his poulterer's in Jermyn Street, but there is not a wing in his closest preserve.

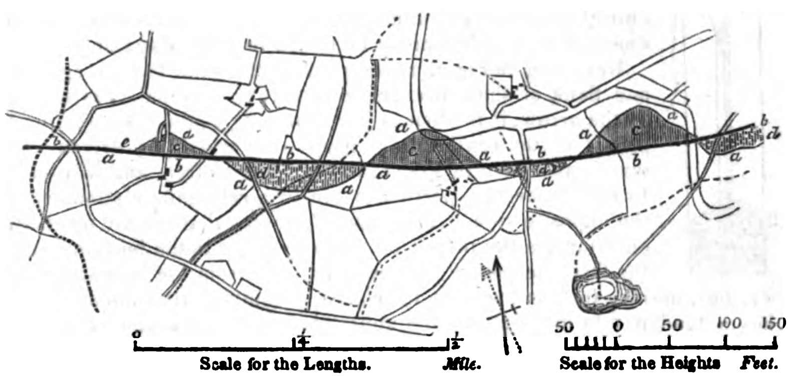
Mr. Macneill, by the invention we are about to notice, has made some small atonement for the terror he spread through the rural population a year or two ago, by his tables for facilitating "cuttings and embankments," and for the attacks his profession has hitherto covertly made upon the country and the dwellers therein, and against which there was little means of defence, for the extent of the evil threatened was always matter of doubt, and could be easily masked by bold assertion. A simple line running across a map, conveyed no notion of the gash that was to be so fearfully cut in that hill, nor of the dam that was to destroy the perspective of that valley, and choke the old acquaintance that once ran free and gurgling from one side of it to the other. It spoke not of viaducts from which passengers can now look into the chamber-windows of his mansion; and what was there in the solution of its continuity, those dots merely, by which tunnels could be predicted, in which nitrogen will never linger, and darkness be never dissipated? Yet, if this simple line be not early washed out from the map, by a process more expensive than a king's ransom, it may be legalized, may curse the ground on each side within a parliamentary boundary, driving out the astonished possessor, and teaching a fatal lesson of the consequence of "being troubled with a *line*."

But the enemy cannot now make so secret an approach; he can no longer blind his victims by his worse than useless "Plan and Section." The prayer of Ajax is granted, to all who ask it, and would to all who don't, if those who make and unmake "Standing Orders" would do their duty.* Railroads must assuredly, in certain cases, be executed: but the mischief necessarily attendant and consequent upon these numerous, and often gigantic, projects, ought to be seen, and easily seen, by every eye, very long beforehand. Hitherto this has been impossible, principally from the difficulty of getting at a correct notion of where, in a vertical as well as in an horizontal direction, the railway was to go. The annexed specimen of a new mode of delineation, invented by Mr. Macneill, and designated SECTIO-PLANOGRAPHY, will show, at a glance, that this difficulty can be removed. Here, on the same surface, in close and natural combination, are,—the virgin surface of the earth previous to the visit of the fell engineer, and the plan-line and the section-line of the railway proposed,—the offspring of his unholy contact. Each may be contemplated by itself, or in combination with either or both of the others. Look at the natural surface-line, (*a a*,) and you can ascertain its correctness, &c.; for every point in it may be recognised by its juxta-position with the plan-line. Look at the plan-line, (*b b*); there may be seen, as usual, its direction, and its relation to lateral objects; but at every point in it you can estimate the facilities or the difficulties, by the coincidence with, or the departure above or below the surface-line, (*a a*). Now, suppose the paper were cut through along the latter line, (*a a*), and that, preserving the plan-line, (*b b*), in its present plan, the superior edges of the surface-line (*a a*), were elevated, and its inferior edges depressed, the whole section might be conceived to be turned upon the plan-line, (*b b*), as upon an axis, till it became vertical; it is now a section of the country, in its correct po-

* "Give me to see, and Ajax asks no more."—*Pope's Homer.*

sition as to the surface, and it gives a perfect representation of what must be done at all and every part of the line, to obtain the railroad at the given level. But the cutting of the paper is unnecessary. Raise the map with the section-plan so delineated from the table, and hang it on the wall. Now the section is vertical, and in its natural position, as before. Once familiarized with these experiments, neither is any longer necessary. A *coup-d' œil* of a sectio-plan laid down upon a map is no longer a limited and merely superficial view as in former years. It shows, previous to a great and important operation being performed, the wounds and the tumefactions which must be produced by the operator, however skilful, and if the party whose estate is to be operated upon is still "recusant," he can ascertain if it be worth while to cut his own throat, or that of the engineer, before the professional "cuttings" of the latter scare away the mountain-nymphs of his home.

Specimen of the Application of the Sectio-Planography, in the Delineation of a Survey for a Railroad.



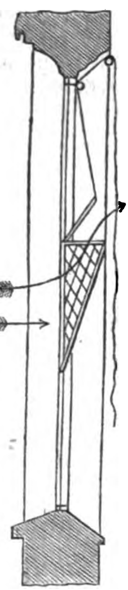
a Natural surface of the ground.
b The proposed Railroad.
c Its passage through elevated ground ; a case of "*Cutting*."
d Its passage across depressed ground ; a case of "*Embankment*."
e Its passage along level ground. Mag. Popular Sci.

On the Ventilation of large Buildings by the Intervention of Openings in the Windows; by R. Mallet.

When in Liverpool, last September, at the meetings of the British Association, I went once to St. Jude's church. This edifice, which is in a sort of Gothic style, presents, when filled with people, a very imposing interior; partly from its magnitude intrinsically, but much more from this property not being, as it is so often, frittered away by innumerable divisions and subdivisions of parts, in the arrangement of ornaments on walls and ceilings. The ceilings are in this church particularly good, being simply divided across by the tie-beams (or representations of them) of the roof principals, which are moulded in a very bold style, and terminate at the walls in rich open Gothic brackets. The under line of these mouldings passes level and straight across, while the ceiling forms a large angle at the centre, probably

of about 160°; thus giving an aspect of great strength and solidity. But to the point. There are two rows of windows at either side, one over and one under the galleries; and each window has a considerable portion of the sash cut out, and inclined inwards, and so fixed; with glazed sides and an open top, furnished with a glazed lid to open and shut by a cord. Fig. 1, is a section of one of these, which represents them all, and is sufficiently plain without reference. The doors are judiciously contrived to prevent the currents of air which are often so distressing in churches; and hence ventilation may be considered as confined to these openings in the windows. Now, while the church is filling, and for, perhaps, the first half hour or so of service, nothing can be better than the ventilation: a delightful *aura* spreads through every part of the building, and feels fresh and breezy; but as the church heats this rapidly declines; and in about an hour, on putting my hand to one of the ventilators, where there had been a strong current in before, I could find none perceptible. This struck me as curious; and, on a little subsequent consideration, I believe I have seen the cause; and, as a great number of churches and other buildings are ventilated in this way, I have deemed it possibly worthy of notice in your Magazine.

Fig. 1.



Referring to Fig. 2, and supposing the wind to blow against one flank of the church, either direct or diagonally, as shown by the arrow, it is obvious that, pressing against the inclined planes of the ventilators, a portion of it will be driven upwards, as shown in Fig. 1, and into the church, and will tend to expel a certain portion of air, by a retrogade motion from the opposite side. The opposing forces that the air meets in entering are the inertia of the body of air in the building, and the force necessary to expel part of it from the leeward windows; but, besides this, as the air in the church becomes heated and ascends, it has a tendency to lodge above the upper row of windows, and, from the commencement of the process, gives a greater freedom of entrance to the fresh air below than above; but, as soon as the hot air above has increased

Fig. 2.

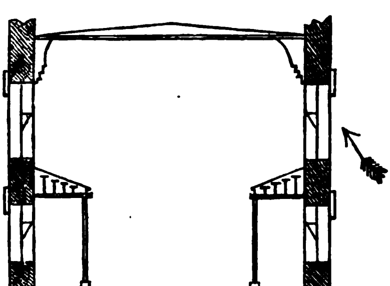
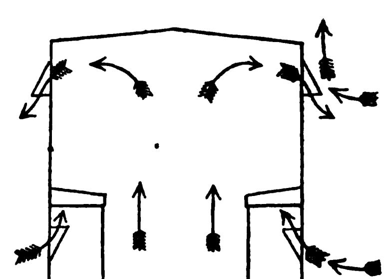


Fig. 3.



so as to have reached the level, or below the top, of the upper row of ventilators, the whole, or a part, of the current through them becomes stopped, depending on the temperature of the upper region; because this air to be displaced by fresh air, requires to be depressed into air colder, and hence denser, than itself, owing to the structure and position of the ventilators;

so that, in fact, at a certain period, dependent on the circumstances of external and internal cooling and heating agencies, the heated air becomes itself a valve to stop out the fresh air. Now the remedy for this is very plain, and consists merely in inverting one set or range of ventilators, as in Fig. 3, where I have represented a section of the church merely by lines. Here the upper ventilators are inverted; so that a lateral external current, instead of, as before, being urged by the inclined plane against the issuing hot air, is deflected upwards by it outside the building; while the slope of the ventilator gives at both sides free egress to the heated air, at the same time that the position of the lower ventilators is the best possible for freely admitting the external atmosphere. This is shown in the figure by the directions of the arrows, together with the ascending currents of heated air. The protection from rain is equally good in either case; and this latter modification would appear to afford a good and efficient system of church ventilation. Architec. Mag.

Death of Arthur Woolf.

The council of the Institution of Civil Engineering, have to regret the loss to the institution by death of its member, Arthur Woolf. This distinguished individual was born at Camborne, in Cornwall. He was a millwright, and in that capacity went to London, and was employed in Meux's brewery. In 1804, he took out a patent for his two-cylinder engine, working high-pressure steam in a small cylinder, and allowing it to expand in a large one. When he first commenced erecting engines in Cornwall, he induced the proprietors of the foundries to improve their machinery, that a better style of workmanship might be used in the manufacturing of steam-engines; and he introduced an improved Hornblower's double-beat valve. The work done at the Consolidated Mines, proves him to have been a person of great talents. In October, 1814, the average duty of the engines in Cornwall was 20½ millions—Woolf's engine at Wheal Abraham, however, performed 34 millions—and in December, 1815, 52 millions; and in May, 1816, 57 millions; while the average duty of all the engines reported in Cornwall was 23 millions. In 1820, Mr. Woolf erected engines at the Consolidated Mines having cylinders of 90 inches in diameter, and a stroke of 10 feet—the most powerful that had ever been constructed. In December, 1827, a trial took place with one of Woolf's 90-inch engines, and it performed a duty of 63½ millions—the average duty of 47 engines reported in this year was 32 millions. For some years before his death he received a pension of 100*l.* a year from the proprietors of the Consolidated Mines. His name is associated with the improvement in the drainage of the Cornish mines; and whatever share posterity may assign to his individual genius in these improvements, his name is recorded in the page of history among those who have dedicated their talents and the opportunities of a long life to the advancement of practical science. Jour. Arts & Sci.

Plymouth Breakwater.

The violent gales of the 24th and 25th of Feb. last, produced their effects on the Breakwater at Plymouth, and owing to its greater exposure, they were mostly confined to the western area. So great was the force

of the sea, that 8,000 tons of stone from the outer fore shore, or foundation of the structure, were fairly lifted by it, and thrown from the outside over this wall of masonry into the sound. It is a curious fact, that the mass of these stones were principally lifted from opposite the circular end on which the lighthouse is to stand, and deposited in an E. N.E. direction from whence they came, thus showing the direction in which the action of the sea was strongest. The upper part of the Breakwater also suffered severely, many large granite blocks, weighing from three to nine tons, of which it is formed, (being firmly cemented and dove-tailed into each other,) having been displaced and washed over into the sound. This is supposed to have arisen from the compactness of the work not allowing the free escape of the water in the body of the structure when acted on by the great pressure of the external waves. Upwards of 250 tons of this work have been displaced, and carried over to the north side of the Breakwater. The tide on this occasion rose 5 feet 6 inches higher than usual, and within 6 inches of the great tide of 1824, when a breach was made by the sea in the main body of the work. Nautical Mag.

Mechanics' Register.

New Cordage.

The brothers Landauer, of Stuttgard, have obtained a patent for a new species of cordage; the threads of which are not twisted one over the other, but united in a parallel direction. A cord, $1\frac{1}{4}$ inch in circumference, sustained a weight of 1300lbs. without breaking; and when at last an additional weight caused it to break, the fracture resembled a cut with scissors, which proves that each thread was of equal strength. A cord of 504 threads, $3\frac{5}{16}$ inches in circumference, 111 feet long, woven in this manner, only weighed 19lbs.; whilst an ordinary cord of the same circumference and length, and as many threads, weighed $51\frac{1}{2}$lbs. Mech. Mag.

Mr. Crosse's Experiments.

The *Morning Post* publishes a letter which Mr. Clark has received from Mr. Crosse, relative to the result of the interesting experiments which the latter gentleman has undertaken for the development of insect life in solutions of silica (flint) by the long continued application of voltaic electricity. Mr. Crosse, in his letter, says, "I send you by my friend, Mr. ——, a small bottle of spirits of wine, containing about thirty insects, produced in silicate of potash, under the long-continued action of voltaic electricity. I am quite as much surprised and quite as much in the dark about this affair as I was at first. I have had lately several new families of them, and have them at this present time growing on a piece of iron-wire plunged into silicate of potash, and a quarter of an inch under the surface of the fluid, at the positive pole of a battery consisting of twenty pairs of small zinc and copper cylinders. I likewise have them forming on the surface of constantly-electrified sulphate of

copper, at the edge of the fluid, and strangely mixed up with crystals of sulphate of copper. In fact, I have them in all stages, from their earliest formation to full perfection, and crawling about pretty nimbly. Most of these formations took place in the dark. The access of light is very prejudicial to them, as far as I have observed. I have hundreds of vessels of the same water as that used in the solution in the same room, and in other rooms, with not the slightest appearance of a similar insect, or the germ of one. In one of these experiments the vessel was covered with paper, and yet the insects were formed as before. Of course I have no merit to claim in the affair; it was pure accident, and the looking for artificial minerals brought them to my notice." Mr. Crosse states that he is preparing an apparatus to repeat the experiments in a more unexceptionable manner, and until then does not wish to enter into detail on the subject. Mining Jour.

New Invented Steam Engine.

At the British Alkali Works, Stoke Prior, near Bromsgrove, a steam engine has been invented by a labouring mechanic, and is daily in full operation, which will certainly supersede every other now in use, and that, too, in a very short period of time; as the simplicity of its construction, the smallness of its size, and the almost nothingness of its cost, will necessarily bring it speedily into notice among all persons whose business may require the aid of so useful an auxiliary. Its size is not more than twice that of a man's hat, and the expense of a five-horse power will not exceed in cost half a score pounds. Its form is cylindrical, being about eighteen inches in diameter, and twenty-two deep. The steam is admitted through a hole in a hollow circular belt (attached to a wall), upon which it revolves, and works it by a diagonal action, against an upright piston, being forced out by pressure of a diagonal plate, which divides the interior into two portions. The rotary action is beautifully managed by means of a perfectly spherical steam-tight joint, at the end of a fixed inclined arm, towards which joint the upper and lower surfaces of the interior part of the cylinder are made to slope, after the form of an hour-glass. Upon these the diagonal plate performs its revolutions, such movement being permitted through an opening (from the circumference to the centre), equal in width to the thickness of the before-mentioned upright piston, up and down the sides of which it continually works. To the centre of the bottom of the cylinder is fixed a shaft, having attached to it a wheel which communicates the motion that may be required; and this is all the machinery of which it consists!! When, therefore, we consider the saving of weight of metal, size, and expense, which will necessarily be gained by its adoption, and look at the incalculable advantages which such desiderata afford to steam navigation, our scientific friends will not consider us too bold in asserting that this invention will speedily revolutionize the whole system in this department of mechanics. Patents have been procured from every European government, and from the American; and no secret is made at the Works in showing it to the public, either in action or in separate pieces, and in a model which is kept for the purpose. Ibid.

The Stafford Safety Coach.

This invention was described some time back. Since that time a coach built on the principle of the patentee, has been running to Nottingham, and has perfectly answered the object of the builders. The great desideratum is the safety of the coach from being overturned, however great the inequality of the surface of the road may be, or in the event of the wheels on one side being lifted from the road upon the pathway, or upon any heap of gravel or rubbish on the road-side, by the horses becoming unmanageable, or by any other occurrence that may propel the carriage out of the ordinary run of the road. The body of the coach being suspended upon springs placed nearly at the top of the coach, and supported upon strong pieces of timber, forming almost an angle, which are at the lower extremities inserted in the axletrees of the front and hind wheels, is kept under all circumstances in a perpendicular position, and the centre of gravity is thrown considerably lower than in coaches built upon the old and common plan. Increased speed may be used without danger by this invention. The carriage is also much lighter; it is calculated that one-horse power is saved in the draught, and the wear and tear is also less. This coach may be used on roads of all constructions, and will not be liable to the danger which arises from coaches traveling upon roads high in the middle or low on the sides, or rounded in the old-fashioned mode of road-making. Most roads are now completely flat, which secures safety to vehicles built on the old plan, but it greatly increases the county rates, by causing the necessity of employing additional labour to scrape off the mud and water which gather on them, but which if they were constructed on a curve, would be unnecessary. The safety coach proceeded yesterday with a heavy load of passengers from Brickfriars to Hayes. In going down Notting-hill it was driven with great velocity, perhaps at the rate of sixteen miles an hour; nevertheless there was no rocking nor jolting. The body preserved its equilibrium in the roughest parts of the road, and fully answered the purposes for which the patent has been granted. Farmers' Mag.

Thrashing Machine.

A thrashing machine manufactured by Mr. L. Beare, of Meeth, near Hatherleigh, has been lately put to work on a farm in the parish of Landkey, near Barnstaple, when an acre of barley was taken in, and thrashed in eighteen minutes, yielding forty bushels of grain. Many respectable farmers were present, and expressed themselves highly pleased and satisfied with the performance of this surprising machine, as the barley was perfectly fit for seed or malting, every grain being free from damage. Ibid.

Relative height of the Caspian and the Black Sea.

The trigonometrical survey of the country situated between these seas, undertaken by order of the present Emperor of Russia, have now been completed. Several interesting results derived from this survey, has been communicated in a letter lately addressed by the celebrated astronomer *Struve*, of the University of Dorpat, to M. Von Humboldt. Among other disputed points which the engineers engaged on this work have established, is the relative height of the Caspian and the Black sea. They have ascertained that the Caspian lies 101 Russian feet (twenty-four French feet) below the level of the Black Sea. A full report is shortly to be published in the *Bulletin Scientifique* of the St. Petersburgh Academy. Min. Review.

Concentric Galvanic Piles.

M. Jules Guyot has just announced the construction of galvanic piles of a peculiar form, which he calls concentric piles. In these piles one pole is at the centre, and the other at the circumference. New properties and remarkable analogies are said to result from this combination, as we find at the surface of spherical piles made to revolve, all the influences of gravity and terrestrial magnetism at the surface of our globe. A pile four inches in diameter, composed of concentric cylinders two inches high and six in number, being charged with pure water, gives strong shocks even after the lapse of twenty-four hours. Mining Jour.

Voyages of Discovery.

These expeditions are not now confined to England, France, or Russia, but private merchants have entered upon them. The house of Grenut, & Co., of Geneva, who carry on a large trade in the whale fishery in the North and South Seas, are fitting out one of their largest whalers for a voyage round the world, without any limitation of time, for the purpose of prosecuting zoological and botanical discoveries. They have made an offer to an eminent naturalist at Geneva, to convey him, without charge, to all places of interest, upon condition of his placing in the museum of that city the collection which he may form. The expense of the voyage is to be defrayed from the private purse of the Baron de Grenut, and his public spirit is much applauded.—*Italian Paper.*

Ibid.

Sugar from the Pumpkin.

A complete revolution is expected to take place in the manufacture of native sugar—a revolution which will probably compel the beet-root growers to "hide their diminished heads." In other words, the pumpkin is about to enter the field as a rival of the beet-root, and to force the Chamber of Deputies to revise its late enactment on the sugar question. We hear that an industrious speculator is on the point of establishing a manufactory for extracting sugar from this overgrown and hitherto despised production of the vegetable world, the first experiments on which, it is added, have been crowned with complete success.—*French Paper.* Ibid.

Iron Steamers.

The iron steam vessel, *Voador*, has, we understand, arrived at Pernambuco, after a passage of actual steaming of only four and a half days from Maranham. Sailing vessels are generally, we believe, twenty or thirty days making this passage, and a fast-sailing vessel arrived at Pernambuco two days before the *Voador*, that had been thirty-five days on the voyage from Maranham. This proves the great advantage to be derived from the introduction of steam vessels on a coast where the current and wind prevail so as to prevent sailing vessels accomplishing their passage in a reasonable time, and must shortly lead to the adoption of steam vessels both on the east and west coast of South America.—*Gore's Liver. Adv.* Ibid.

AGENCY FOR PATENTS.

The Editor has again opened his office in Washington for the transaction of all business relative to Domestic and Foreign Patents. See advertisement on the cover.

There are no Occultations of Stars to the sixth magnitude visible in Philadelphia, in the month of February, 1839.

S. C. WALKER.

Meteorological Observations for August, 1838.

Moon.	Days	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inch's	Inch's			Inches.	
	1	74	87	29.80	29.80	W.S.W.	Calm.		Clear—flying clouds.
	2	67	84	90	30.00	N.N.E.	Brisk.		Lightly cloudy—clear.
	3	64	84	30.00	00	W.N.W.	do.		Clear—flying clouds.
	4	64	87	10	10	W.	Calm.		Clear—flying clouds.
☺	5	69	85	00	29.93	W.	do.		Lightly cloudy—do. do.
	6	74	94	29.70	75	N.	do.	.45	Clear—showers.
	7	74	91	80	80	W.N.W.	Brisk.		Lightly cloudy—do. do.
	8	71	87	30.00	30.09	E.N.E.	do.		Lightly cloudy—cloudy.
	9	77	82	00	29.94	S.SW.	Ca'm.		Cloudy—flying clouds.
	10	73	85	29.90	90	N.W.	Brisk.		Cloudy—do.
	11	73	70	90	77	S.W.	Calm.		Lightly cloudy—cloudy.
☽	12	72	85	74	74	N.W.	Brisk.	.75	Clear—fly. cl'ds.—rain in night.
	13	67	84	90	94	N.W.	Calm.		Clear—do.
	14	64	76	30.04	30.05	E.	Brisk.		Cloudy—cloudy.
	15	59	79	10	07	S.W.	Calm.		Clear—cloudy.
	16	68	82	29.90	29.90	S.	do.	.13	Cloudy—cloudy—rain in night.
	17	70	79	60	70	N.W.	Moderate.		Clear—flying clouds.
	18	65	70	80	73	W.	Calm.		Clear—clear.
⊗	19	62	79	95	30.03	W.N.W.	do.		Clear—do.
	20	65	82	30.10	13	E.	do.		Clear—do.
	21	65	84	13	10	S.W.	do.		Cloudy—do.
	22	71	90	10	04	W.SW.	do.		Clear—do.
	23	73	86	.06	07	S.W.	do.		Cloudy—clear.
	24	69	89	.02	29.91	S.W.	do.		Clear—do.
	25	72	89	29 85	80	W.S W.	do.		Cloudy—clear.
	26	72	77	70	72	N.N.W.	do.		Clear—flying clouds.
	27	54	69	81	87	N.N E.	do.		Lightly cloudy—do. do.
☾	28	70	83	64	66	N.	do.		Cloudy—flying clouds.
	29	61	80	92	30.00	N.N.E.	Moderate.		Clear—do.
	30	68	84	30.00	29.90	N.N.E.	Calm.		Cloudy—clear.
	31	60	82	00	90	W.S.W.	do.		Clear—do.
	Mean	64 42	82.74	29.92	29.91			1.33	

	Thermometer.	Barometer.
Maximum height during the month.	94. on 6th.	30.13 on 20th and 21st.
Minimum " " "	54 27th.	29.60 17th.
Mean	73.58	29.91

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AMERICAN PATENTS, LIST OF, WITH EDITOR'S REMARKS, &c.